NAVAL POSTGRADUATE SCHOOL
MONTEREY, CALIFORNIA

THESIS

**A STRUCTURED APPROACH
TO
INFORMATION TECHNOLOGY MANAGEMENT
IN THE
DEPARTMENT OF DEFENSE**

By

Paul Robert Logan

September 1994

Principal Advisor: Carl R. Jones
Associate Advisor: James C. Emery

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Information technology management (ITM) in the Department of Defense (DoD) has changed significantly during the 1980's and early 1990's. The pace of this change seems only to be accelerating as computer processing power continues to increase, data storage and retrieval capacity continues to grow, telecommunications capabilities continue to improve, hardware and software become more readily available, and automation costs continue to decrease. Managers need to understand the answers to the following questions in order to manage DoD IT effectively and efficiently: 1) What impact are the Information Age and the Military Technical Revolution having on the DoD? 2) How can managers engineer and manage IT in the DoD more effectively and efficiently? and 3) What new applications of IT are now possible in the DoD? The author created and tested in class a course designed to help prepare military personnel and defense civil servants (DoD civilians) to serve as technical managers of defense-related IT. The course uses an integrated set of learning materials that provides answers the three questions presented above. Material covered by the course includes: Module 1 - The Military Technical Revolution: The Changing DoD IT Environment, Module 2 - A Structured Approach to ITM in the DoD: The Structured Approach Framework, Module 3 - A Structured Approach to ITM in the DoD: The Structured Approach Process, and Module 4 - Command and Control Warfare: An Application of ITM in the DoD.

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A STRUCTURED APPROACH TO INFORMATION TECHNOLOGY MANAGEMENT IN THE DEPARTMENT OF DEFENSE

by

Paul R. Logan
Captain, United States Army
BS, United States Military Academy, 1984

Submitted in partial fulfillment of
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September 1994

Author: _____
Paul Robert Logan

Approved by: _____
Carl R. Jones, Principal Advisor

_____
James C. Emery, Associate Advisor

_____
David R. Whipple, Chairman,
Department of Systems Management

ABSTRACT

Information technology management (ITM) in the Department of Defense (DoD) has changed significantly during the 1980's and early 1990's. The pace of this change seems only to be accelerating as computer processing power continues to increase, data storage and retrieval capacity continues to grow, telecommunications capabilities continue to improve, hardware and software become more readily available, and automation costs continue to decrease. Managers need to understand the answers to the following questions in order to manage DoD IT effectively and efficiently: 1) What impact are the Information Age and the Military Technical Revolution having on the DoD? 2) How can managers engineer and manage IT in the DoD more effectively and efficiently? and 3) What new applications of IT are now possible in the DoD? The author created and tested in class a course designed to help prepare military personnel and defense civil servants (DoD civilians) to serve as technical managers of defense-related IT. The course uses an integrated set of learning materials that provides answers the three questions presented above. Material covered by the course includes: Module 1 - The Military Technical Revolution: The Changing DoD IT Environment, Module 2 - A Structured Approach to ITM in the DoD: The Structured Approach Framework, Module 3 - A Structured Approach to ITM in the DoD: The Structured Approach Process, and Module 4 - Command and Control Warfare: An Application of ITM in the DoD.

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LIST OF SYMBOLS, ACRONYMS AND ABBREVIATIONS

AA	Academic Associate
ADP	Automated Data Processing
AI	Artificial Intelligence
AIS	Automated Information System
AM	Amplitude Modulation
AUTODIN	Automatic Digital Network
AUTOVON	Automatic Voice Network
CCC	CINC Command Complex
CINC	Commander-In-Chief
CNO	Chief of Naval Operations
C2	Command and Control
C2W	Command and Control Warfare
C3	Command, Control and Communications
C3I	Command, Control, Communications and Intelligence
C4I	Command, Control, Communications, Computers and Intelligence
C4IFTW	C4I For The Warrior
CASE	Computer-Aided Software Engineering
CJCS	Chairman of the Joint Chiefs of Staff
CUDIX	Common User Digital Information Exchange

CWC	Component Warfare Commander
DA	Department of the Army
DCS	Defense Communications System
DDN	Defense Data Network
DISA	Defense Information Systems Agency
DoD	Department of Defense
DODD	Department of Defense Directive
DoN	Department of the Navy
DSS	Decision Support System
ES	Expert System
ESR	Educational Skill Requirement
EW	Electronic Warfare
FLTSATCOM	Fleet Satellite Communications
FM	Frequency Modulation
FSBS	Fixed Submarine Broadcast System
FTS-2000	Federal Telecommunications System 2000
GCCS	Global Command and Control System
GENSER	General Service
GLOBIXS	Global Information Exchange System
GPS	Ground Positioning System
I-CASE	Integrated Computer-Aided Software Engineering

I/O	Input / Output
IAW	In Accordance With
ICAM	Integrated Computer-Aided Manufacturing
ICOM	Input, Control, Output, Mechanism
IDEF	ICAM Definition Method
ILS	Integrated Logistics System
IM	Information Management
Info	Information
INFOSEC	Information Security
IR	Information Resources
IRM	Information Resource Management
IS	Information System
IT	Information Technology
ITM	Information Technology Management
JCS	Joint Chiefs of Staff
JOPES	Joint Operation Planning and Execution System
JOTS	Joint Operational Tactical System
JMCIS	Joint Maritime Command Information System
JTF	Joint Task Force
JTIDS	Joint Tactical Information Distribution System
LAN	Local Area Network

LEASAT	Leased Satellite
LDMX	Local Digital Message Exchange
MLS	Multi-Level Security
MNS	Mission Need Statement
MOFE	Measure(s) Of Force Effectiveness
MOP	Memorandum Of Policy or Measure(s) Of Performance
MTR	Military Technical Revolution
NAVCOMPARS	Naval Communications Processing and Routing System
NAVMACS	Naval Modular Automated Communications System
NCA	National Command Authority
NCTS	Naval Computer and Telecommunications Station
NCTAMS	Naval Computer and Telecommunications Area Master Station
NPS	Naval Postgraduate School
NTDS	Navy Tactical Data System
NTS	Navy Telecommunications System
OA	Operations Analysis
OMB	Office of Management of the Budget
OO	Object Oriented
OOP	Object Oriented Programming
ORD	Operational Requirements Document
ORSA	Operations Research and Systems Analysis

OSS	Operational Support System
OTCIXS	Officer in Tactical Command Information Exchange System
PCM	Pulse Code Modulation
PIM	Planned, Incremental Modernization
R&D	Research and Development
RD&A	Research, Development, and Acquisition
RDT&E	Research, Development, Testing, and Evaluation
RIXT	Remote Information Exchange Terminal
RMA	Revolution in Military Affairs
SA	Structured Approach
SAF	Structured Approach Framework
SAM	Structured Approach Model
SAP	Structured Approach Process
SADT	Structured Analysis and Design Technique
SATCOM	Satellite Communications
SEW	Space and Electronic Warfare
SSIXS	Submarine Satellite Information Exchange System
STREAMLINER	Shore-based, Processor-controlled Message Switching System for Special Intelligence Message Traffic
TADIL	Tactical Digital Information Link
TADIXS	Tactical Data Information Exchange System

TAFIM	Technical Architecture For Information Management
TBA	To Be Announced
TBD	To Be Determined
TCC	Tactical Command Center
TLSR	Top Level System Requirement(s)
TRM	Technical Reference Model
US	United States
USA	United States America
USAF	United States Air Force
USN	United States Navy
WAN	Wide Area Network
WIN	WWMCCS Intercomputer Network
WWMCCS	World-Wide Military Command and Control System

I. INTRODUCTION

Information technology management (ITM) in the Department of Defense (DoD) has changed significantly during the last two decades. The pace of this change seems only to be accelerating as computer processing power continues to increase, data storage and retrieval capacity continues to grow, telecommunications capabilities continue to improve, hardware and software become more readily available, and automation costs continue to decrease. [Ref. 1, p. 19] Managers of information technology (IT) in the DoD need to understand the answers to the following questions in order to manage DoD IT effectively and efficiently in an operating environment characterized by rapid and continuous change:

1) What impact are the Information Age and the Military Technical Revolution having on the DoD?

2) How can managers engineer and manage IT in the DoD more effectively and efficiently?

3) What new applications of IT are now possible in the DoD?

The ITM curriculum (#370) at the United States Naval Postgraduate School (NPS) in Monterey, California is designed to prepare military personnel and defense civil servants (DoD civilians) to serve as technical managers of defense-related IT. This thesis, hereafter referred to as an "instructional report," presents answers to the three questions presented above in a format that facilitates 1) NPS graduate student education, 2) Instructor presentation of the material introduced in this instructional report, and 3) The development of a new thesis format for presenting student research findings as instructional material for classes at NPS.

A. PURPOSE

The purpose of this instructional report is threefold: 1) To serve as a student text for future classes at NPS, 2) To serve as an instructor's guide for teaching these classes, and 3) To serve as a model for a new type of NPS thesis report called an "instructional report."

1. The Student Text

This instructional report provides students at NPS with a student outline or study guide for learning about the following subjects: 1) The Military Technical Revolution

(MTR), 2) A Structured Approach to Information Technology Management in the DoD, and 3) Command and Control Warfare (C2W). This instructional report also contains an introduction to the thesis process at the Naval Postgraduate School (NPS).

2. The Instructor Guide

This instructional report provides faculty members at NPS with a teaching guide or instructional outline for presenting a course that introduces the subjects listed above.

3. The Instructional Report Prototype

This instructional report contributes to the establishment of a new type of thesis report at NPS. It does this by providing a format for presenting material from student research in a textbook-like format. This new type of thesis, the instructional report, will complement the two existing types of NPS thesis reports: the common thesis research report and the thesis technical report. [Ref. 2]

B. OBJECTIVES

There are three sets of objectives for this instructional report: 1) Student text objectives, 2) Instructor guide objectives, and 3) Instructional report prototype objectives.

1. The Student Text

The objectives for the student text are:

1) Facilitate student learning by providing a logical, organized way to study the material introduced in this instructional report.

2) Stimulate student interest by presenting some of the issues and challenges associated with the subjects introduced in this instructional report.

3) Develop student ability to analyze and critique course material through graded and non-graded study questions and exercises.

4) Assist student research and inquiry by providing lists of resources and references. The resources and references listed in this instructional report serve as a starting point for further study of the material introduced in this instructional report.

2. The Instructor Guide

The objectives for the instructor guide are:

1) Facilitate instructor preparation for teaching class by providing a course schedule, learning objectives, references, reading assignments, and study questions for each module and submodule.

2) Facilitate instructor presentation of the subject matter by providing a logical, organized way to cover the material in class.

3) Facilitate instructor development of student knowledge concerning the subject matter by providing material for use in class lectures and discussions.

4) Facilitate instructor evaluation of student understanding of the subject matter by providing module and submodule learning objectives, study questions, and exercises.

5) Facilitate instructor guidance of students who want to learn more about the subject matter by providing resource reference lists.

3. The Instructional Report Prototype

The objectives for the instructional report prototype are:

1) Contribute to the establishment of a new type of thesis report at NPS by providing an example or sample format for presenting student research findings as student texts or course supplements for use in classes at NPS. Two characteristics of this new type of thesis report are:

   a) General enough to be used by many of the departments and academic groups at NPS, yet specific enough to contribute to the education of NPS students.

   b) Modular in design with individual modules and submodules possessing a high degree of internal cohesion and a low degree of coupling. This gives instructors optimum flexibility when preparing and presenting material for a course.

2) Stimulate interest in producing instructional reports as part of the continuing effort to improve the quality of classes and their supporting instructional material at NPS.

3) Complement the two existing types of thesis reports at NPS: the thesis research report and the thesis technical report.

C. TARGET AUDIENCES

There are three target audiences for this instructional report: 1) NPS Students, 2) NPS Instructors, and 3) NPS Faculty and Staff.

1. NPS Students

The student target audience for this instructional report includes the following:

1) NPS Information Technology Management (ITM) students enrolled in IS3112 in fulfillment of Education Skill Requirements (ESR's) for the ITM curriculum (370). See Appendix D, ITM Education Skill Requirements, for a listing of ESR's for the ITM curriculum and an explanation of each ESR.

2) NPS students in curricula other than the ITM curriculum (370) who need to satisfy ESR's the same as or similar to those in the ITM curriculum (370). See Appendix D, ITM Education Skill Requirements, for a listing of ESR's for the ITM curriculum and an explanation of each ESR.

3) NPS students who have successfully completed or validated the prerequisite courses listed in Appendix C, IS3112 Course Prerequisites, or their equivalents.

4) Other individuals having both an interest in the subject matter and a need to know who meet the minimum security requirements for the course. See Chapter II, Course Organization and Administration, for security considerations.

2. NPS Instructors

The instructor target audience for this instructional report includes the following:

1) NPS instructors responsible for teaching IS3112 to satisfy ITM ESR's. See Appendix D, ITM Education Skill Requirements, for a listing of ESR's for the ITM curriculum and an explanation of each ESR.

2) NPS instructors responsible for teaching other classes at NPS which satisfy ESR's the same as or similar to those listed in Appendix D, ITM Education Skill Requirements.

3) NPS instructors having both an interest in the subject matter and a need to know, who meet the minimum security requirements for the course. See Chapter II, Course Organization and Administration, for security considerations.

3. NPS Faculty and Staff

The NPS faculty and staff target audience for this instructional report includes the following:

1) NPS faculty and staff responsible for establishing policy and standards for NPS thesis research and documentation (thesis reports).

2) NPS faculty and staff interested in developing a more effective way to use NPS thesis research to improve the quality of student education at NPS by presenting research findings in the format of an instructional report instead of a thesis research report or a thesis technical report.

D. METHODOLOGY

The author of this instructional report followed two different, but complementary methodologies to produce this instructional report; one for the content of the student text and instructor guide and another for the format of the instructional report.

1. Student Text and Instructor Guide Development

The author developed the content of this instructional report using the following process:

1) Assess the need for modifying or recreating an existing NPS course: CM3112 - Navy Telecommunication Systems (September - December 1993).

2) Analyze the existing course: CM3112 (September 1993 - March 1994).

   a) Analyze the existing course name and description.

   b) Analyze the existing learning objectives.

   c) Analyze the existing course syllabus.

   d) Review and evaluate the existing course materials.

3) Develop a new course based on the findings of 1) and 2) above (January - March 1994).

   a) Develop new course learning objectives.

   b) Create a new course name and number: IS3112 - ITM in the DoD.

c) Select new course materials.

(1) Discard useless course materials from CM3112.

(2) Replace outdated course materials from CM3112 with updated versions.

(3) Search for and add new course materials.

d) Develop a new course outline.

e) Develop new course syllabi.

(1) Create a "Master Syllabus" containing general information about the course (course organization and administration).

(2) Create a "Detailed Syllabus" containing specific class information.

4) Refine the new course, IS3112 - ITM in the DoD, through repeated evaluation and modification. The author and principal advisor developed the items listed in paragraph 3 above using an iterative process (March - April 1994).

5) Teach the new course, IS3112 - ITM in the DoD, to 28 NPS ITM students (March - June 1994). This pilot class consisted of two ITM students from the September 1994 NPS graduating class and 26 ITM students from the March 1995 NPS graduating class. Professor Carl R. Jones, the Principal Advisor for this instructional report and the NPS ITM curriculum (370) Academic Associate (AA) served as the primary instructor for this class. The author of this instructional report assisted Professor Jones by presenting 12 hours of class instruction and by helping with the administration of the course. Professor James C. Emery, Associate Advisor for this instructional report, attended and actively participated in IS3112 classes, assisting with class administration and providing suggestions for the improvement of course content and format.

6) Evaluate the new course, IS3112 - ITM in the DoD, continuously throughout its administration. The author and the principal advisor made adjustments to the course as needed (March - June 1994).

7) Re-evaluate the new course and restructure weak areas (July - August 1994).

8) Reorganize course material (August - September 1994).

9) Write this instructional report in preparation for teaching the new course (IS3112) a second time from September to December 1994 (September 1994).

2. Instructional Report Development

The author developed the format for this instructional report in close cooperation with Professor Carl R. Jones, the Academic Associate for the ITM curriculum (370) and Principal Advisor for this instructional report. The author developed the format for this instructional report using the following process:

1) Examine the organization of the old course: CM3112 - Navy Telecommunications Systems (September 1993 - September 1994).

2) Examine the organization of the new course: IS3112 - ITM in the DoD (March - September 1994).

3) Examine the format for both the common NPS thesis research report and the thesis technical report (July - August 1994).

4) Obtain initial approval from the NPS Dean of Instruction to develop a format for a new type of thesis report to be called an "Instructional Report" (August 1994).

5) Develop the initial structure for this instructional report (August 1994).

6) Refine the format for this instructional report (August - September 1994).

7) Finalize and reproduce this instructional report (September 1994).

8) This instructional report will undergo further refinement and revision as NPS faculty and staff evaluate and modify it as part of the process of establishing a new type of thesis report for NPS.

The two processes which produced this first version of this instructional report proceeded simultaneously from September 1993 through September 1994. Evaluating and refining both the content and the format of this instructional report should continue long after the initial publication and distribution of this document, making this first ever NPS instructional report a "living document."

E. ORGANIZATION

The author organized this instructional report to serve all of the purposes stated in Section A above and to meet all of the objectives listed in Section B above. There are two ways to view the organization of this instructional report: the organization of the overall instructional report (the format of the instructional report) and the organization of the student text and instructor guide (the content of the instructional report).

1. Overall Instructional Report

This instructional report follows the basic format of a standard NPS thesis research report with only a few exceptions. This instructional report has introductory material, a main body, references, appendices, and an initial distribution list in accordance with current NPS thesis report guidelines. [Ref. 2] The main difference between a standard NPS thesis research report or thesis technical report and this instructional report lies in the organization of the material in the chapters of the report's body. The author organized the material contained in each chapter of this instructional report into blocks of instructional material called modules and submodules. Modules and submodules contain information that is unlikely to change as instructors and students use the instructional report in support of classes. The appendices of the instructional report contain information that is likely to change often, such as instructor information, course grading scheme, and course schedule. The page, figure, and table numbering scheme of this instructional report also reflects the modular construction of this instructional report. To illustrate:

1) I-8 means, "Chapter I, page 8."

2) M2-4 means, "Module 2, page 4."

3) M3C-3 means, "Module 3, Submodule C, page 3."

4) G-4 means, "Appendix G, page 4."

5) E-14-1 means, "Appendix E, Subappendix 14, page 1."

2. Student Text and Instructor Guide

The author organized this instructional report into chapters, modules, and submodules as listed in the table of contents.

a. Chapters

Chapters contain the main areas of interest in this instructional report:

1) Course Organization and Administration (Chapter II).

2) The Military Technical Revolution: The Changing DoD IT Environment (Chapter III).

3) A Structured Approach to Information Technology Management in the DoD (Chapter IV).

4) Command and Control Warfare (C2W): An Application of ITM in the DoD (Chapter V).

5) Course Retrospective (Chapter VI).

Chapters III through V contains detailed blocks of instruction called modules.

1) Chapter III contains Module 1.

2) Chapter IV contains Modules 2 and 3.

3) Chapter V contains Module 4.

b. Modules

This instructional report contains four major blocks of instruction called modules. Each module covers one topic that contributes to the overall theme of the instructional report. This instructional report contains the following modules:

1) Module 1 - The Military Technical Revolution: The Changing DoD IT Environment.

2) Module 2- A Structured Approach to Information Technology Management in the DoD: The Structured Approach Framework.

3) Module 3- A Structured Approach to Information Technology Management in the DoD: The Structured Approach Process.

4) Module 4- Command and Control Warfare: An Application of ITM in the DoD.

c. Submodules

The author further divided two of the modules in this instructional report into submodules. Submodules contain logical subsets of the material covered by the parent module. Submodules facilitate learning by reducing the complexity of the overall concept(s) or topic(s) covered by the parent module and by reducing the volume of the material covered at one time to a more manageable size. Modules two (2) and three (3) contain submodules as follows:

1) Module 2 - A Structured Approach to Information Technology Management in the DoD: The Structured Approach Framework.

   a) Submodule A - Functional Considerations.

b) Submodule B - Physical Considerations.

c) Submodule C - Organizational Considerations.

2) Module 3 - A Structured Approach to Information Technology Management in the DoD: The Structured Approach Process.

a) Submodule A - Organizing and Planning.

b) Submodule B - Defining the System Problem.

c) Submodule C - Assessing the Baseline System.

d) Submodule D - Determining the Target System.

e) Submodule E - Developing Migration Candidates.

f) Submodule F - Selecting a Migration Path.

g) Submodule G - Implementing the System Plan.

h) Submodule H - Maintaining the System Process.

d. Module and Submodule Contents

The author organized all modules and submodules into the following sections:

1) Overview.

2) Learning Objectives.

3) References.

4) Reading Assignments.

5) Study Questions.

6) Exercises.

(1) Overview. The Overview section of each module and submodule provides the reader with a general summary of the material presented in the module or submodule. The overview briefly describes the material covered, its relevance to the theme of the instructional report, its challenges, and its potential impact. The overview may also introduce specific items of interest for the reader.

(2) Learning Objectives. Learning Objectives are key points, items of interest, or specific knowledge elements presented in the chapter, module or submodule. The students are responsible for accomplishing these learning objectives while studying the material contained in the module or submodule. The instructor is responsible for helping the students accomplish the learning objectives for each module or submodule.

(3) References. The References section of each module and submodule lists all of the source materials the author used to develop that particular module or submodule. The References section serves as a bibliography for each module and submodule and is a good place for students or the instructor to begin a search for additional reading material on the subject matter presented in the module or submodule.

(4) Reading Assignments. The Reading Assignments section of each module and submodule lists required student reading for that particular module or submodule. The instructor may tailor these reading assignments to suit specific class educational needs or meet time and schedule constraints.

(5) Study Questions. The Study Questions section of each module and submodule contains questions derived from the material covered by the module or submodule. Each Study Questions section has two parts: General Questions and Specific Questions.

(a) General Questions. General questions are general, broad, conceptual questions which focus on "the big picture." General questions are the types of questions students could expect to see on an examination because they require the student to integrate a wide variety of material from various reading assignments, class lectures, discussions, and projects. General questions often require students to draw on knowledge gained during previous classes at NPS and on practical experience acquired "on the job" or "in the fleet."

(b) Specific Questions. Specific Questions are highly detailed questions taken from specific reading assignments listed in the Reading Assignments section. These questions are not likely to appear on examinations because of their narrow scope, but they do contribute to the development of the student's knowledge about the subject introduced in the module or submodule.

(6) Exercises. The Exercises section of each module and submodule contains possible work assignments for students to complete either in or out of class. These exercises enhance student learning by requiring students to apply the material covered in reading assignments, class lectures, previous NPS classes, prior work experience, etc. in a new and challenging way. Completed exercises may or may not contribute to a student's grade, depending on the instruction plan and grading scheme developed by the course instructor. The course instructor may tailor exercises as necessary to optimize their contribution to the overall learning experience of the students.

II. COURSE ORGANIZATION AND ADMINISTRATION

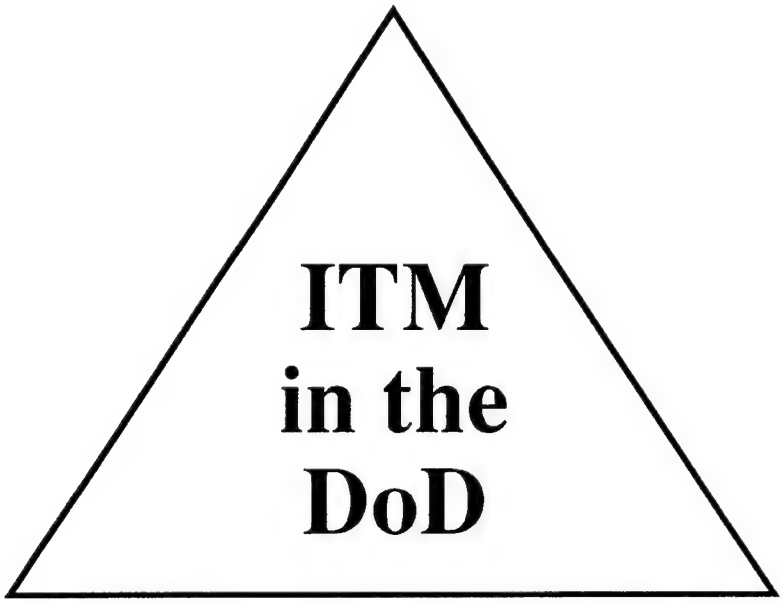

Figure II-1 IS3112 - ITM in the DoD Overview.

A. OVERVIEW

1. Course Introduction

Information technology management (ITM) in the Department of Defense (DoD) has changed significantly during the last two decades. The pace of this change seems only to be accelerating as computer processing power continues to increase, data storage and retrieval capacity continues to grow, telecommunications capabilities continue to improve, hardware and software become more readily available, and automation costs continue to decrease. {Ref. 1, p. 19] Managers of information technology (IT) in the DoD need to understand the answers to the following questions in order to manage DoD IT effectively and efficiently in an operating environment characterized by rapid and continuous change:

1) What impact are the Information Age and the Military Technical Revolution having on the DoD?

2) How can managers engineer and manage IT in the DoD more effectively and efficiently?

3) What new applications of IT are now possible in the DoD?

The ITM curriculum (#370) at the United States Naval Postgraduate School (NPS) in Monterey, California is designed to prepare military personnel and defense civil servants (DoD civilians) to serve as technical managers of defense-related IT. This instructional report presents answers to the three questions listed above in a way that facilitates the education of NPS graduate students who are preparing to become managers of IT in the DoD.

2. Course Content

This instructional report introduces three interrelated topics concerning ITM in the DoD:

1) The Military Technical Revolution (MTR): The Changing DoD IT Environment.

2) A Structured Approach to Information Technology Management (ITM) in the DoD.

3) Command and Control Warfare (C2W): An Application of ITM in the DoD.

The conceptual framework in Figure II-2 below illustrates the contents of the course.

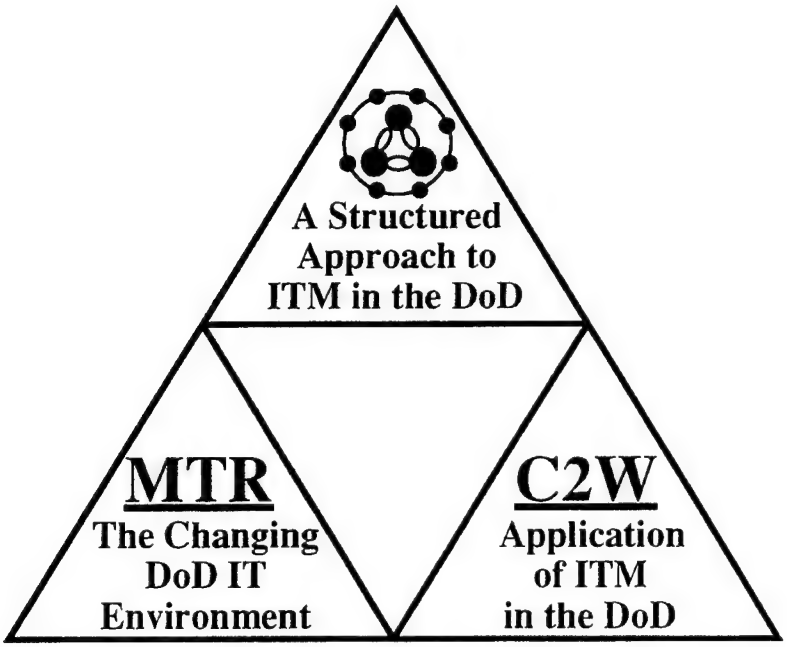

Figure II-2 Course Framework for IS3112 - ITM in the DoD.

Each of these three subject areas addresses one of the fundamental questions presented in the course introduction. The MTR addresses the impact of the Information Age on warfare and some of the implications of this revolution in military affairs. Managers of DoD IT need to understand the changing environment of DoD IT and know how to manage this change. The structured approach to ITM in the DoD presents a systematic way for IT managers to manage IT effectively and efficiently in the turbulent DoD operating environment. Finally, C2W: An Application of ITM in the DoD, introduces students to one of the more important military applications of IT: Command and Control Warfare (C2W).

3. Course Specifics

See Appendix A, Course Specifics, for detailed information on the course instructor, class meeting times and locations, and student academic requirements for the course.

4. Course Schedule

The course schedule for IS3112 is in Appendix B.

5. Course Prerequisites

Students enrolled in IS3112 must meet the prerequisites listed in Appendix C to participate fully in the course.

6. Security Considerations

a. Class Procedures

Some material covered in IS3112 may be classified up to SECRET GENSER (General Service). All IS3112 instructors and students will strictly adhere to all NPS, USN, and DoD security regulations when discussing and handling sensitive materials. All class participants will state in advance if their comments and examples are classified and at what level.

b. Student Clearances

Students enrolled in IS3112 must have at least a current SECRET GENSER security clearance to participate fully in the class.

B. LEARNING OBJECTIVES

1. Course Learning Objectives

There are eight main learning objectives for this course. The author based all module and submodule learning objectives in this instructional report on these eight main objectives. The learning objectives for this course and the module(s) in which they are covered are:

1) Understand the nature and the significance of the changes taking place in the DoD IT environment (Module 1 - The Military Technical Revolution: The Changing DoD IT Environment).

2) Understand the impact of the Military Technical Revolution on systems engineering and IT development in the DoD (Module 2 - A Structured Approach to ITM in the DoD: The Structured Approach Framework).

3) Be able to describe an information system and the organizational decision process(es) it supports in the context of operational and tactical decision making (C2 and C2 support) (Module 2 - A Structured Approach to ITM in the DoD: The Structured Approach Framework).

4) Develop an integrated framework for engineering and managing information technology and systems in DoD organizations (Module 2 - A Structured Approach to ITM in the DoD: The Structured Approach Framework).

5) Be able to apply a structured approach to information systems engineering and management based on the Technical Architecture For Information Management (TAFIM) (Module 3 - A Structured Approach to ITM in the DoD: The Structured Approach Process).

6) Become familiar with selected DoD information systems (Module 3 - A Structured Approach to ITM in the DoD: The Structured Approach Process).

7) Become familiar with the concepts of Command and Control Warfare (C2W) (Module 4 - C2W: An Application of ITM in the DoD).

8) Explore a subject area for thesis research in preparation for formal thesis proposal submission (Appendix G - Thesis Area Definition).

2. Education Skill Requirements (ESR's)

NPS creates, maintains, and administers curricula core courses to meet specific DoD and US Navy ESR's. Meeting ESR's contributes to the preparation of NPS students for their future utilization ("pay-back") tour when they will apply the skills they learned during their NPS graduate school experience for the direct benefit of the DoD and the students'

respective services and agencies. The author and the ITM Academic Associate used the ESR's listed and explained in Appendix D, ITM Education Skill Requirements (ESR's), to redesign CM3112 and transform it into the current IS3112. The author and the ITM Academic Associate based all course, module, and submodule learning objectives on these ESR's. IS3112 satisfies ITM ESR's as indicated below in Table II-1.

ITM Education Skill Requirement (ESR)	IS3112 Module				
	1	2	3	4	G
1. JOINT AND MARITIME STRATEGIC PLANNING			X		
2. INFORMATION SYSTEMS TECHNOLOGY					
a. Computer Systems					
b. Communication Systems and Networks		X			
c. Software Engineering			X		
d. Database Management Systems			X		
e. Decision Support and Expert Systems			X		
3. INFORMATION SYSTEMS ANALYSIS AND MANAGEMENT					
a. Managerial Concepts		X	X		
b. Evaluation of Information Systems		X	X		
c. Systems Analysis and Design		X	X		
d. Management of Information Systems		X	X		
e. Adapting To Technical, Organizational, and Economic Changes	X	X	X		
4. MILITARY APPLICATIONS					
a. DoD Decision Making Process on Information Systems		X			
b. Acquisition Management					
c. DoD Computer and Telecommunications	X	X	X	X	
d. C4I and C2W	X	X	X	X	
5. INDEPENDENT RESEARCH					X

Table II-1 ITM ESR and IS3112 Module Matrix.

C. REFERENCES

The bibliography to this instructional report contains a complete list of references for IS3112. The Reference List found in each module and submodule lists all of the material that the author used to develop the content of the module or submodule. The IS3112 instructor may add new material to the course as it becomes available or as it is needed. Reference lists are a good place for students to begin their search for additional references on the topics introduced in this instructional report. Module and submodule reference lists are in alphabetic order.

D. READING ASSIGNMENTS

The course instructor will assign students specific reading assignments from the Reading Assignments section of each module or submodule. The purposes of module and submodule reading assignments are:

1) To provide the student with background information on the subject covered in the module or submodule.

2) To stimulate student creative and critical thought.

3) To generate student interest in the subject matter.

The course instructor may assign students all, some or none of the suggested reading. The course instructor may also add materials to the assigned reading list. The course instructor should encourage students to search for and read additional material related to module and submodule learning objectives. The author and the ITM Academic Associate listed reading assignments in priority order with the most relevant document listed first and the least relevant document listed last.

E. STUDY QUESTIONS

The Study Questions section of each module and submodule contains questions based on the material covered in the module or submodule. There are two types of study questions in each module and submodule: General Questions and Specific Questions.

1. General Questions

General Questions are broad, conceptual questions which focus on "the big picture." General questions are the types of questions that students could expect to see on an examination because they require students to integrate a wide variety of material from various reading assignments, class lectures, discussions, and projects. General questions often require students to draw on knowledge gained during previous classes at NPS and practical experience acquired "on the job" or "in the fleet."

2. Specific Questions

Specific Questions are highly detailed questions taken from specific reading assignments in each module or submodule. These questions are not likely to appear on an examination because of their narrow scope, but they do contribute to the development of student knowledge on the subject presented in the module or submodule.

F. EXERCISES

The Exercises section of each module and submodule contains a list of possible work assignments for students to complete either in or out of class. These exercises contribute to student education by challenging students to apply the material covered in the reading assignment(s), class lectures, previous NPS classes, prior work experience, etc. Completed exercises may or may not be graded, depending on the instruction plan and grading scheme developed by the course instructor (see Appendix A, Course Specifics). The course instructor may tailor these exercises to optimize their contribution to the overall learning experience of the students. The instructor may also create and assign new exercises as needed. Suspenses for graded exercises are listed in both Appendix A, Course Specifics and Appendix B, Course Schedule.

III. MODULE 1 - THE MILITARY TECHNICAL REVOLUTION:

THE CHANGING DOD IT ENVIRONMENT

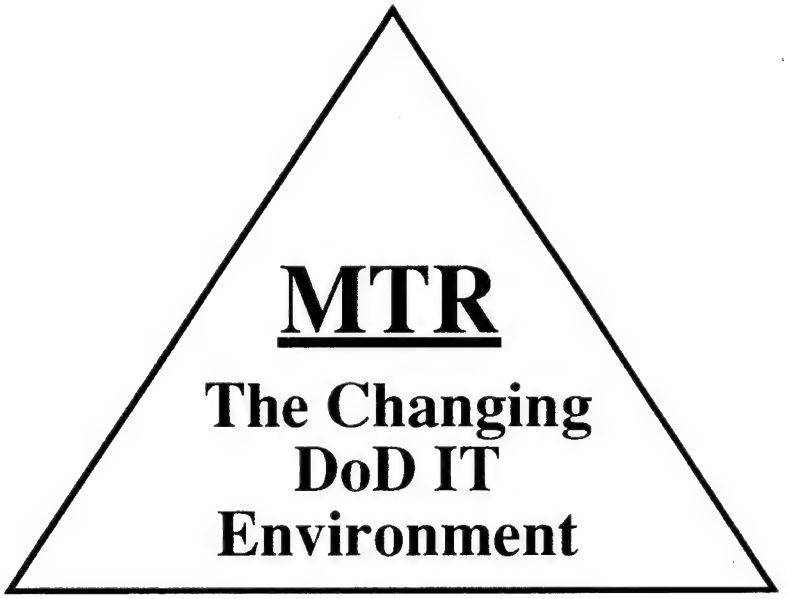

Figure M1-1 Military Technical Revolution (MTR) Overview.

A. OVERVIEW

The Information Age is producing a revolution in command and control, communications, computers, weapons, and Command and Control Warfare (C2W). From classical ADP systems to modern tactical information systems, the DoD is experiencing improvements in horizontal integration, growth of common databases, increases in needs for massive communications capacities, and greater demand for better management, Command and Control (C2), and decision making. Both afloat and ashore, the DoD is continuing to learn how to adapt and apply information technology (IT) to meet the needs of military users throughout the "spear of war," from the "pointy end" to the "support tail." [Ref. 3]

The current Revolution in Military Affairs (RMA) is having a significant impact on both American and allied military matters. IT is generating dramatic changes in Joint and Maritime planning and operations; U.S. national and allied strategies which address the entire spectrum of conflict; the U.S. maritime component of the National Military Strategy;

the organizational structure of the U.S. defense establishment; the role of the Commanders of the Unified and Specified Commands in strategic planning; the process of strategic planning; joint and service doctrine, and the roles and missions of each in meeting national strategy. IT managers in the DoD must understand the impact of the MTR on the DoD in order to effectively manage IT in support of the DoD.

B. LEARNING OBJECTIVES

1) Understand the magnitude of the change (revolution vs. evolution) that recent advances in IT have brought to the DoD.

2) Understand that IT now extends from support facilities ashore or "in the rear" to the "Warriors" at sea and at "the front."

3) Understand that the DoD must manage IT from "cradle to grave," i.e. from acquisition (system development, procurement, and fielding) through migration (system evolution) to retirement (system termination), in order to optimize system functionality and reap the maximum benefit from the investment (benefit vs. cost).

C. REFERENCES

1) Arquilla, John and Ronfeldt, David, *Cyberwar is Coming!,* RAND Library Collection, International Policy Department, RAND, Santa Monica, California, 1992.

2) Cronin, Patrick M., *Silicon and Security in the Twenty-First Century,* Perspectives on Policy and Strategy, Strategic Review, Summer 1992.

3) Echevarria, Antulio J. and Shaw, John M., *The New Military Revolution: Post-Industrial Change,* Parameters, Winter 1992-93.

4) Evans, Dennis K. and Howard III, William E., *Technology for the Digital Battlefield,* Army Research, Development and Acquisition Bulletin, July - August 1994.

5) Gouré, Daniel, *The Military Technical Revolution: The Revolution in Conflict,* Army Research, Development and Acquisition Bulletin, January-February 1994.

6) Inghram, Jonathan D., *Scenario 2010* (Chapter 5), *Tactical Local Area Networks,* M.S. Thesis, Naval Postgraduate School, Monterey, California, March 1992.

7) Matthews, William, *School is in for "Information Warfare,"* Defense Trends, Army Times, May 23, 1994.

8) Mazaar, Michael J., and Shaffer, Jeffrey, *The Military Technical Revolution: A Structural Framework,* Center for Strategic and International Studies, Washington, D.C., March 1993.

9) Schulte, Brigid, *Army's Mock War Invades Cyberspace,* San Jose Mercury News, Tuesday, April 26, 1994.

10) Schwartau, Winn, *Terminal Compromise,* Interpact, 1993.

11) Stein, George J., *Information, War - Cyberwar - Netwar,* Air University, Air War College, Maxwell AFB, Montgomery, AL, TBP.

12) Toffler, Alvin and Heidi, *War and Antiwar: Survival at the Dawn of the 21st Century,* Little, Brown and Company, Boston, 1993

D. READING ASSIGNMENTS

1) Gouré, Daniel, *The Military Technical Revolution: The Revolution in Conflict,* Army Research, Development and Acquisition Bulletin, January-February 1994.

   Class handout.

   Read: Entire document.

2) Inghram, Jonathan D., *Scenario 2010* (Chapter 5), *Tactical Local Area Networks,* M.S. Thesis, Naval Postgraduate School, Monterey, California, March 1992.

   Class handout.

   Read: Entire document.

3) Recommended, but optional:

   a) Stein, George J., *Information, War - Cyberwar - Netwar,* Air University, Air War College, Maxwell AFB, Montgomery, AL, TBP.

   b) Cronin, Patrick M., *Silicon and Security in the Twenty-First Century,* Perspectives on Policy and Strategy, Strategic Review, Summer 1992.

   c) Echevarria, Antulio J. and Shaw, John M., *The New Military Revolution: Post-Industrial Change,* Parameters, Winter 1992-93.

   d) Arquilla, John and Ronfeldt, David, *Cyberwar is Coming!,* RAND Library Collection, International Policy Department, RAND, Santa Monica, California, 1992.

   e) Information Warfare Symposium (video tape), Washington, D.C., June 1994. (See Professor Carl R. Jones to borrow this video tape.)

E. STUDY QUESTIONS

1. General Questions

1) Is the DoD experiencing a revolution or an evolution in military affairs as the result of the advances made in information technology during the 1980's and 1990's?

2) Explain how it is now possible for IT to extend from support facilities ashore or "in the rear" to the "Warriors" at sea and at "the front," creating one seamless, integrated "infosphere."

3) Why must the DoD manage IT from "cradle to grave," i.e. from acquisition (system development, procurement, and fielding) through migration (system evolution) to retirement (system termination)?

2. Specific Questions

See Appendix E-1, The Military Technical Revolution.

F. EXERCISES

None.

IV. A STRUCTURED APPROACH TO ITM IN THE DOD

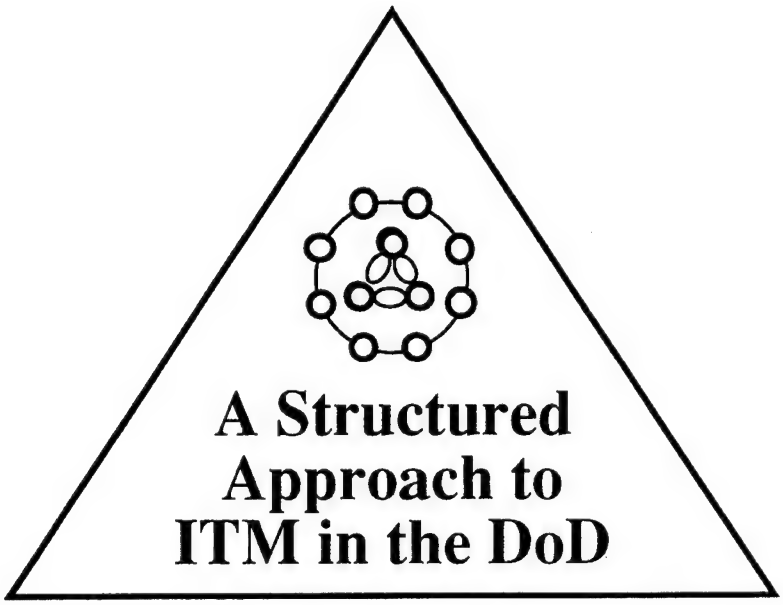

Figure IV-1 A Structured Approach to ITM in the DoD Overview.

A. OVERVIEW

The purpose of this chapter is to introduce a structured approach to engineering and managing systems in a dynamic environment. The goal of this structured approach is to help systems engineers and managers design, build, operate, and maintain (evolve) systems more efficiently and more effectively. Using this structured approach to engineer and manage information technology (IT) in a complex and dynamic organization such as the US Department of Defense (DoD) would be an excellent application of the ideas introduced in this chapter. This structured approach accomplishes its goal through the use of an analytical model called the Structured Approach Model. This chapter overview introduces the Structured Approach Model, its purpose, and its basic components. A more detailed presentation of the Structured Approach Model follows in the modules and submodules of this chapter. Module 2 introduces the Structured Approach Framework which is the centerpiece of the Structured Approach Model. The Structured Approach Framework helps systems engineers and managers understand systems more clearly by providing a structured way to think about and describe systems. The Structured Approach Framework views systems using three different, but related perspectives or frames:

Functional, Physical, and Organizational. The three submodules of Module 2 present these three views and the relationships that exist among them. Module 3 introduces the Structured Approach Process of the Structured Approach Model. The Structured Approach Process provides a methodology for engineering and managing systems throughout their life cycles. The Structured Approach Process has eight steps. The submodules of Module 3 present each of these eight steps and how each relates to and contributes to the larger, continuous process of the Structured Approach Process.

1. The Structured Approach Model

The purpose of this structured approach to systems engineering and management is to help managers engineer, operate, and maintain systems efficiently and effectively. This structured approach does this through the use of the Structured Approach Model. The Structured Approach Model provides an analytical framework for understanding systems and a process for engineering and managing systems. The Structured Approach Model incorporates both a static and a dynamic view of systems. The Structured Approach Model accomplishes this dual view of systems by using two interrelated component models: the Structured Approach Framework and the Structured Approach Process. Figure IV-2 depicts the Structured Approach Model with its two component models. The Structured Approach Framework is located in the center of the Structured Approach Model (the interior). The Structured Approach Process surrounds the Structured Approach Framework (the exterior of the Structured Approach Model).

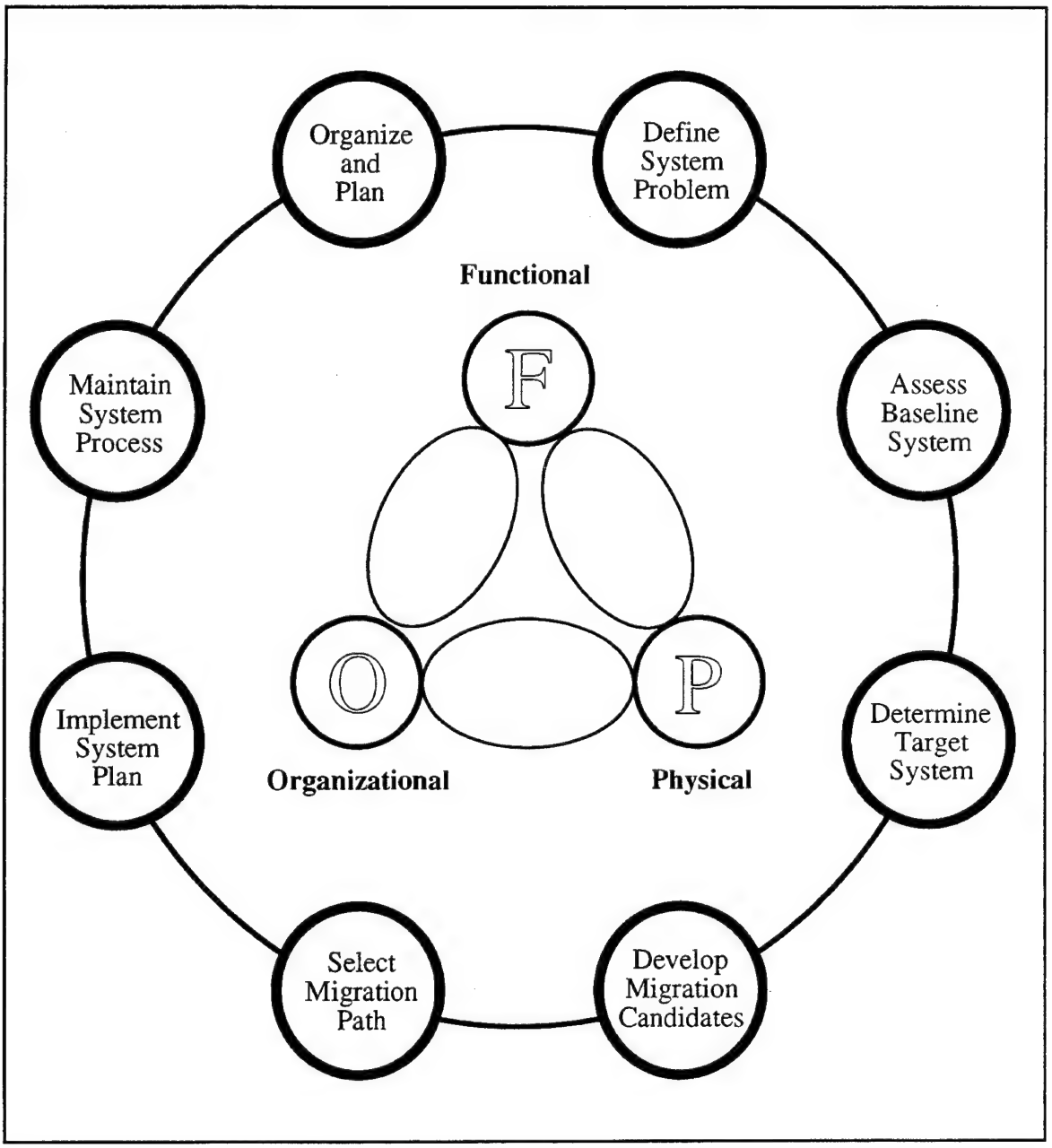

Figure IV-2 The Structured Approach Model: Framework (interior) and Process (exterior).

a. The Structured Approach Framework

Effective and efficient systems engineering and management requires systems engineers and managers who understand the system-in-focus. [Ref. 4] The purpose of the Structured Approach Framework is to help system engineers and managers understand the system-in-focus more clearly by helping them view the system from three different, but related, perspectives or frames: Functional, Physical, and Organizational. The Functional perspective helps systems engineers and managers understand a system by examining and describing the functions that a system must perform to meet system requirements. The Physical perspective helps systems engineers and managers understand a system by examining and describing the physical resources required by a system to perform its functions. The Organizational perspective helps systems engineers and managers understand a system by examining and describing the configuration and the coordination required for the system to function effectively and efficiently. The Structured Approach Framework graphically depicts these three principal views of a system and the relationships among them. The Structured Approach Framework provides a static view or "snapshot" of a system from each of these three perspectives. These static system views help systems engineers and managers understand the principal components (subsystems) of a system and the relationships among those subsystems at one point in time. Systems engineers and managers may use the Structured Approach Framework alone or in conjunction with the Structured Approach Process. That is why the Structured Approach Framework is positioned in the center of the Structured Approach Model, surrounded by the Structured Approach Process. The submodules of Module 2 present the components of the Structured Approach Framework, the relationships among them, and the procedures for applying the Structured Approach Framework.

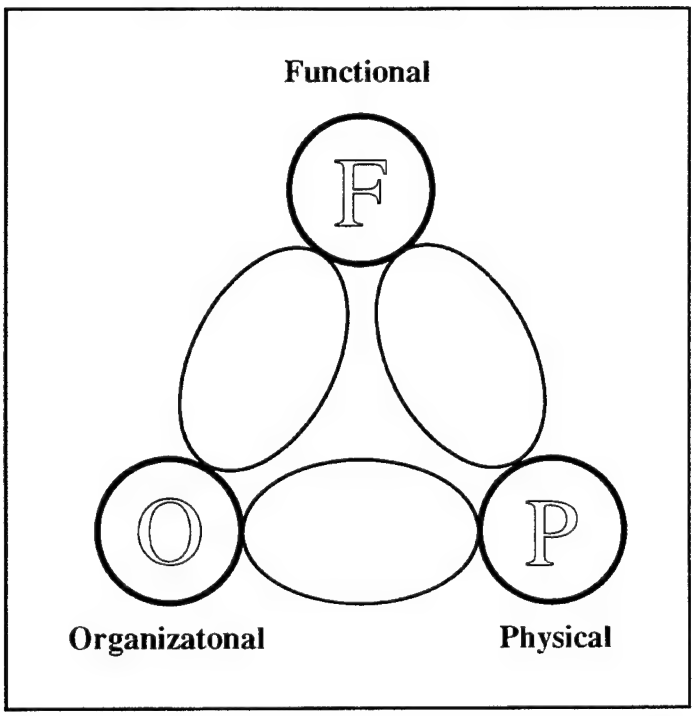

Figure IV-3 The Structured Approach Framework.

b. The Structured Approach Process

Once systems engineers and managers have an understanding of the system-in-focus, they need a methodology for engineering and managing the system throughout its life cycle. The Structured Approach Process meets this need by providing an eight-step process for designing, building, operating, and maintaining a system over time. In this way, the Structured Approach Process provides systems engineers and managers with a dynamic view of a system. The Structured Approach Process has eight steps, each of which is a process by itself. Completing each of these eight steps provides systems engineers and managers with a "piece of the puzzle" or a "part of the solution" to the problems of engineering, operating, and evolving a system effectively and efficiently throughout its life cycle; "cradle to grave." System engineers and managers should use the Structured Approach Framework as an engineering tool in each of the steps of the Structured Approach Process. The Structured Approach Framework is situated in the center of the Structured Approach Process to illustrate the relationship between the Structured Approach Framework and the Structured Approach Process. The submodules of Module 3 present each of the eight steps in the Structured Approach Process.

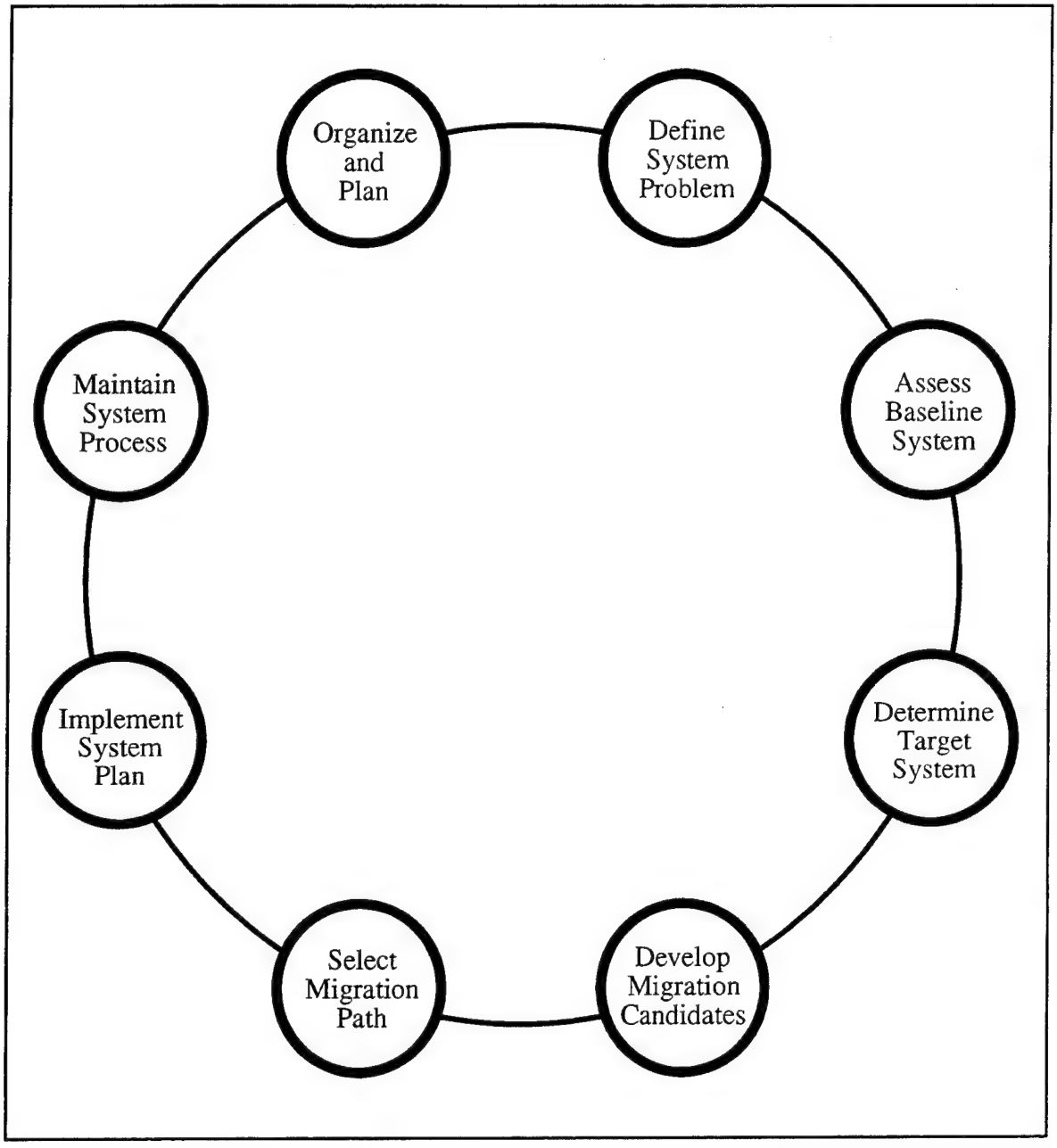

Figure IV-4 The Structured Approach Process.

2. Structured Approach Summary

The purpose of this structured approach to systems engineering and management is to help engineers and managers design, build, operate, and manage systems throughout their life cycles. The structured approach does this through the use of the Structured Approach Model. One way to view the Structured Approach Model is as a system of systems. The Structured Approach Model is a system embedded within the system of the environment in which it is being used. The Structured Approach Model has two subsystems embedded within it: the Structured Approach Framework and the Structured Approach Process. These two subsystems each have their own embedded subsystems. The Structured Approach Framework has three subsystems: the Functional component (subsystem), the Physical component (subsystem), and the Organizational component (subsystem). The Structured Approach Process has eight steps. Each step is a system (a process) by itself. Each step is also a system embedded within the larger system of the Structured Approach Process.

It is important for systems engineers and managers to understand the concept of embedded systems, but it is even more important for systems engineers and managers to be able to identify and understand the relationships among systems. This is important because systems never operate in isolation. They always affect, and are affected by, other systems. There are always interactions between and interdependencies among systems. Systems engineers and managers must realize and understand this principle to design, build, operate, and maintain systems that will be viable (function effectively and efficiently) in their operating environments. Subsystems have relationships with their parent system, with each other, and with their own internally embedded subsystems. [Ref. 5]

The graphical representation of the Structured Approach Model reflects both the embedded nature of systems and the relationships among these systems. The components of the Structured Approach Model are circular in appearance with one system (the Structured Approach Framework) situated inside the other (the Structured Approach Process). This positioning illustrates the relationship between these two models. Each of the smaller components (subsystems) in the Structured Approach Framework and the Structured Approach Process is represented graphically by a circle to illustrate that each framework component or process step is also a system. Thus, the entire graphical

representation of the Structured Approach Model illustrates an important principle: systems consist of connected, interrelated, and embedded subsystems.

B. LEARNING OBJECTIVES

1) Understand that systems are composed of other (embedded) systems (subsystems).

2) Understand that relationships exist among systems. A system affects and is affected by other systems.

3) Understand the problems that may occur from describing systems in a linear way (e.g. a systems design specification document).

4) Understand the differences between a static view of a system and a dynamic view of a system and how each contributes to effective systems engineering and efficient systems management.

C. REFERENCES

This section of each module and submodule lists references for the modules and submodules of this chapter.

D. READING ASSIGNMENTS

Reading assignments are listed in this section of each module and submodule within this chapter. The assigned readings in each module and submodule are not intended to give students detailed knowledge of the topic(s) presented in the module or submodule. The assigned readings are only intended to:

1) Provide students with the minimum essential background information they need to understand class lectures and participate in class discussions on the subject matter.

2) Stimulate critical and creative student thought on the subject matter.

3) Generate further student interest in the subject matter.

E. STUDY QUESTIONS

1. General Questions

1) Explain the embedded systems concept and its importance to systems engineering and management.

2) Explain why systems should not be viewed as linear processes and the impact of this idea on systems engineering and management.

3) Explain the two views of systems engineering and why using these two views are important to systems engineering and management.

2. Specific Questions

None.

F. EXERCISES

None.

MODULE 2 - A STRUCTURED APPROACH TO ITM IN THE DOD:

THE STRUCTURED APPROACH FRAMEWORK

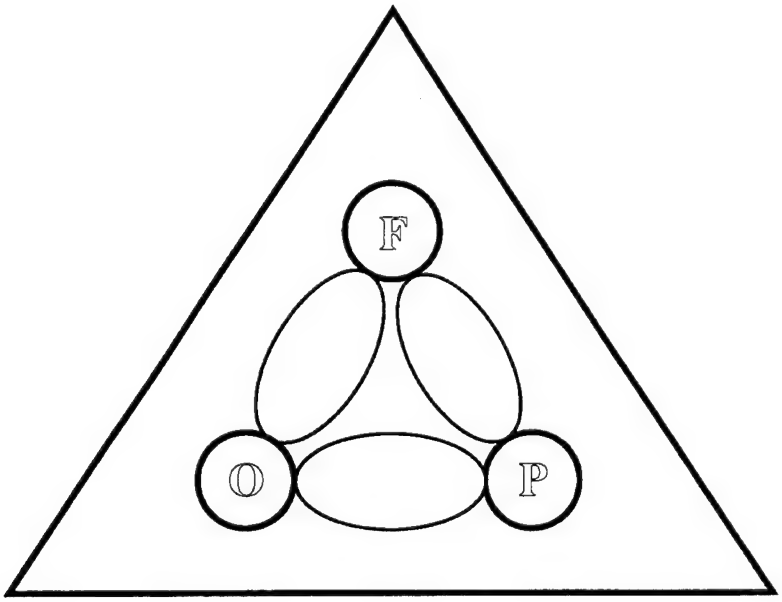

Figure M2-1 The Structured Approach Framework Overview.

A. OVERVIEW

The purpose of this module is to review several fundamentals of systems engineering and to present the centerpiece of the Structured Approach Model: the Structured Approach Framework. This module overview introduces a few fundamentals of systems engineering, the Structured Approach Framework, its purpose, its relationship to the Structured Approach Model, and its components. The Structured Approach Framework has three components: the Functional component, the Physical component, and the Organizational component. A more detailed presentation of these components follows in the three submodules of this module. Submodule A presents the Functional component. Submodule B presents the Physical component. Submodule C presents the Organizational component. Each submodule provides an overview of the subject matter, learning objectives, reference material, reading assignments, study questions, and exercises for approximately one week (four hours) of class lectures, discussions, and homework. The instructor may choose to use all, some or none of the submodules in this module, depending on the course learning

objectives, the course schedule, and the instructor's student evaluation plan. Any apparent redundancies in either material or format between submodules is intentional. Redundancy increases the cohesiveness of submodules while minimizing coupling (interdependency) among submodules. Some of the ideas covered in the assigned readings, class lectures, and class discussions of this module are:

1) Defining a System
    a) Interrelated Elements in an Environment
    b) The System-Environment Boundary
    c) The System-in-Focus Concept
    d) Description vs. Prescription
    e) Static vs. Dynamic
    f) Open vs. Closed
2) Describing Systems
    a) Modeling Systems

        IDEF0

        IDEF1X

    b) Systems Architectures

        Architecture Definitions

        Characteristics of Architectures

        Examples of Architectures

            Cooperative Engagement Figures

            INCA Intelligence Goal Architecture

            TAFIM Volume III Examples

                Client / Server Architecture

                Communications Architecture

                Security Architecture

b) Systems Architectures (Continued)

Similarities in Architectures

Functional Characteristics

Physical Characteristics

Organizational Characteristics

1. The Structured Approach Model

The purpose of this structured approach to systems engineering and management is to help managers design, build, operate, and maintain systems efficiently and effectively. This structured approach does this through the use of the Structured Approach Model. The Structured Approach Model provides an analytical framework for understanding and describing systems. The Structured Approach Model also provides a process for engineering and managing systems. The Structured Approach Model incorporates both a static and a dynamic view of systems. The Structured Approach Model accomplishes this through two interrelated component models: the Structured Approach Framework and the Structured Approach Process. Figure M2-2 depicts the Structured Approach Model with its two components. The Structured Approach Framework is located in the center of the Structured Approach Model (the interior). The Structured Approach Process surrounds the Structured Approach Framework (the exterior of the Structured Approach Model).

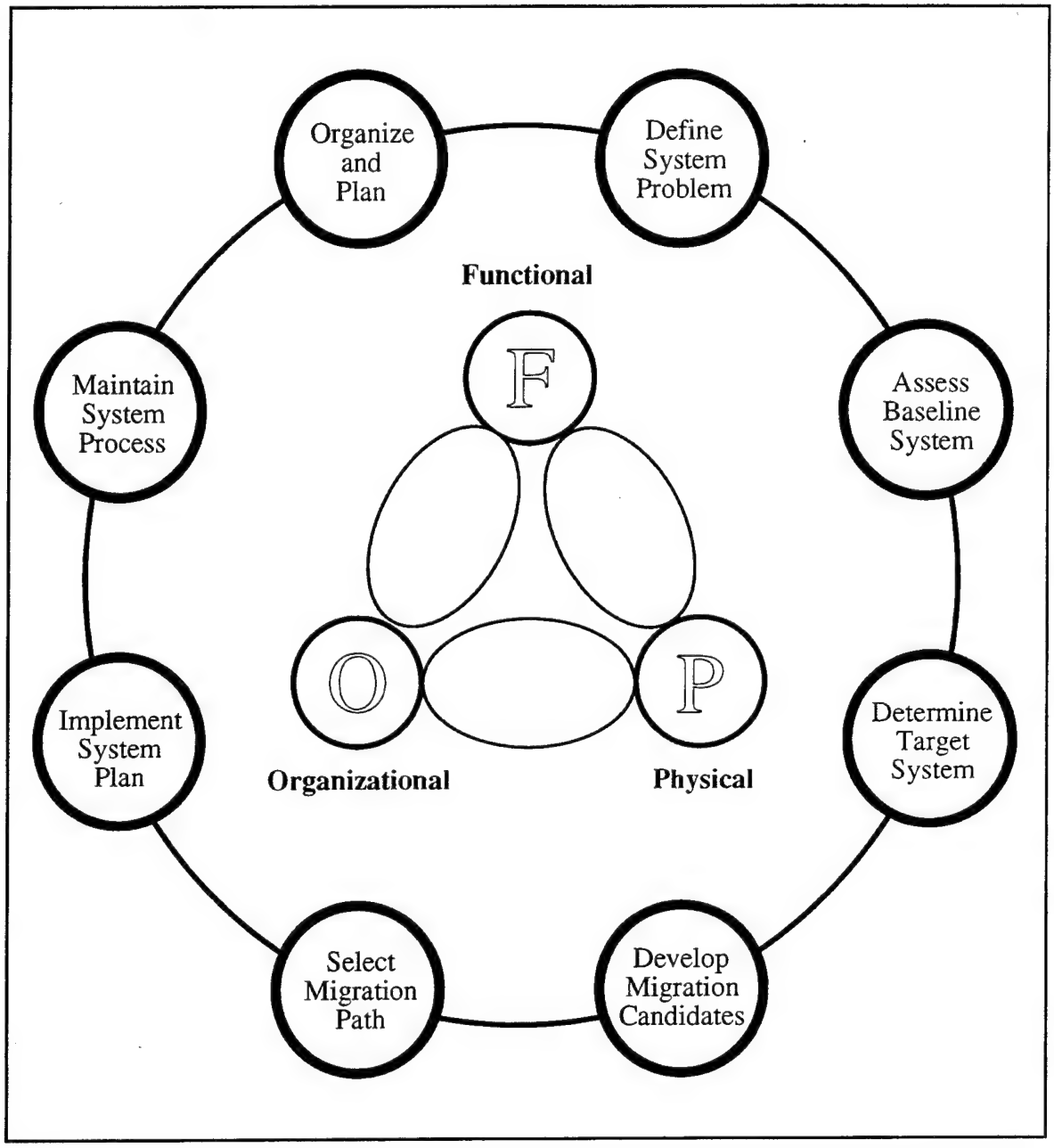

Figure M2-2 The Structured Approach Model: Framework and Process.

2. The Structured Approach Framework

Effective and efficient engineering and management requires systems engineers and managers who understand the system-in-focus. The purpose of the Structured Approach Framework is to help system engineers and managers understand the system-in-focus more clearly by helping them view the system from three different, but interrelated perspectives or frames: Functional, Physical, and Organizational. The Functional perspective helps systems engineers and managers understand a system by examining and describing the functions that the system must perform to meet system requirements. Submodule A presents the Functional view and its relationship to the Physical and Organizational views. The Physical perspective helps systems engineers and managers understand a system by examining and describing the physical resources required by the system to perform its functions. Submodule B presents the Physical view and its relationship to the Functional and Organizational views. The Organizational perspective helps systems engineers and managers understand a system by examining and describing the configuration and the coordination required for the system to function effectively and efficiently. Submodule C presents the Organizational view and its relationship to the Functional and Physical views. The Structured Approach Framework graphically depicts the three principal views of a system and the relationships among them. The framework provides a static view or "snapshot" of a system from each of these three perspectives. These static system views help systems engineers and managers understand the principal components (subsystems) of systems and the relationships among those subsystems at a single point in time. Systems engineers and managers may use the Structured Approach Framework alone or in conjunction with the Structured Approach Process. That is why the Structured Approach Framework is positioned in the center of the Structured Approach Model, surrounded by the Structured Approach Process.

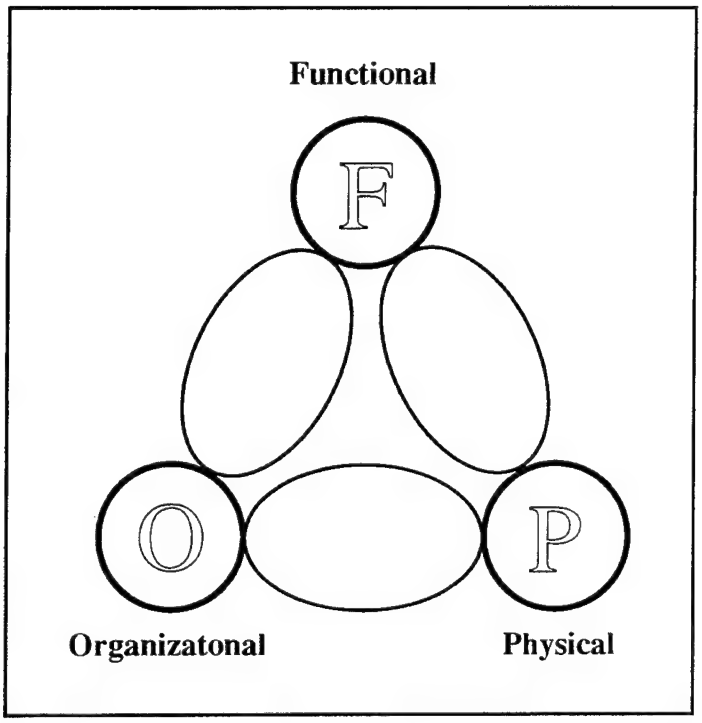

Figure M2-3 The Structured Approach Framework.

a. Functional Considerations

The Functional component of the Structured Approach Framework is concerned with the functions or activities that a system must perform to serve its overall purpose. Viewing a system from a Functional perspective provides answers to the basic question, "What is the system supposed to do?"

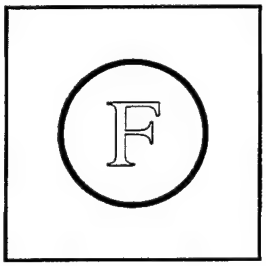

Figure M2-4 The Functional Component of the Structured Approach Framework.

Submodule A introduces the Functional system view and its relationship to the Physical and Organizational system views.

b. Physical Considerations

The Physical component of the Structured Approach Framework is concerned with the physical assets and resources that a system requires to function or operate. Viewing a system from a Physical perspective provides answers to the basic question, "With what does the system have to work?" or "What does the system need to function?"

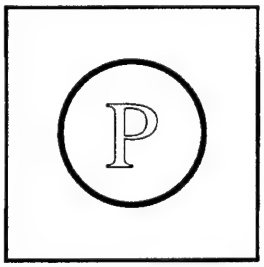

Figure M2-5 The Physical Component of the Structured Approach Framework.

Submodule B introduces the Physical system view and its relationship to the Functional and Organizational system views.

c. Organizational Considerations

The Organizational component of the Structured Approach Framework is concerned with the configuration, structuring or organization of the system to serve its overall purpose. Viewing a system from an Organizational perspective provides the answers to the basic question, "How is the system organized to function?"

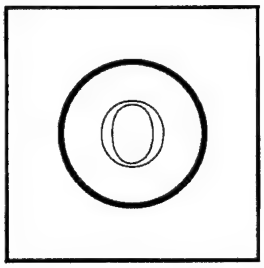

Figure M2-6 The Organizational Component of the Structured Approach Framework.

Submodule C introduces the Organizational system view and its relationship to the Functional and Physical system views.

3. Structured Approach Framework Summary

The Structured Approach Framework provides a way to view a system from one or more different perspectives so systems engineers and managers can more easily understand the components of the system and how they are interrelated. Integrating the three fundamental ways to view and describe a system contributes to a more complete understanding of the system, its components, and the relationships among the components.

B. LEARNING OBJECTIVES

1) Understand that there are three fundamental ways to view and describe a system.

2) Understand that the three fundamental ways to view and describe a system are all interrelated.

3) Understand that integrating the three fundamental ways to view and describe a system contributes to a more complete understanding of the system, its components, and the relationships among the components.

C. REFERENCES

1) Beer, Stafford, *The Viable Systems Model: Its Provenance, Development, Methodology and Pathology,* Journal of the Operational Research Society, Vol 35, No. 1, Operational Research Society, Ltd., Great Britain, 1984.

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18) Jones, Carl R., *Functional Analysis and Allocation*, Class Notes, Naval Postgraduate School, Monterey, California, December 4, 1993.

19) Jones, Carl R., *Developing Functional Architectures*, Class Notes, Naval Postgraduate School, Monterey, California, September 13, 1992.

20) Jones, Carl R., *Synthesizing Buildable Systems,* Class Notes, Naval Postgraduate School, Monterey, California, December 5, 1993.

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26) Moore, John, *Business Process Reengineering: The Feds Go Back to the Drawing Board,* Business Process Reengineering: The Feds Go Back to the Drawing Board, A Supplement to Federal Computer Week, September 20, 1993.

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37) Swan, G., *Understanding the Organizational Decision Process at the Theater Commander-in-Chief Level of Command,* M.S. Thesis, Naval Postgraduate School, Monterey, California, March 1992.

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40) Type A Specification Template, Department of Defense, Washington, D.C., 1988.

41) USMC, *Command and Control,* FMFM 3.

42) USMC, *Volume I: Command and Control - The Foundation,* February 23, 1994.

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44) Viable Systems International, *The Viable System Model of a multi-hospital system* (Illustration).

45) Viable Systems International, *The Viable System Model of Stafford Beer,* (Illustration).

46) Waltz, Edward and Llinas, James, *Multisensor Data Fusion,* Artech House, Boston, 1990.

47) Whitten, Jeffrey L., Bentley, Lonnie D., and Barlow, Victor M., *Systems Analysis and Design Methods,* 2nd Ed., Irwin College Publishing, Homewood, Illinois, 1989.

D. READING ASSIGNMENTS

1) Jones, Carl R., *Some Fundamental System Science Concepts* from *Introduction to Systems Engineering and Science,* Class Notes, Naval Postgraduate School, Monterey, California, June 12, 1993.

   Class handout.

   Read: Entire document.

E. STUDY QUESTIONS

1. General Questions

1) What are the three fundamental ways to view and describe a system?

2) How are the three fundamental ways to view and describe a system interrelated?

3) What are the benefits of integrating the three fundamental ways to view and describe a system?

2. Specific Questions

Specific study questions are listed in this section of each submodule in this module, when applicable.

F. EXERCISES

The course instructor may assign exercises from the assigned reading to reinforce student learning of the material presented in the assigned readings, class lectures, and class discussions.

MODULE 2 - THE STRUCTURED APPROACH FRAMEWORK

SUBMODULE A - FUNCTIONAL CONSIDERATIONS

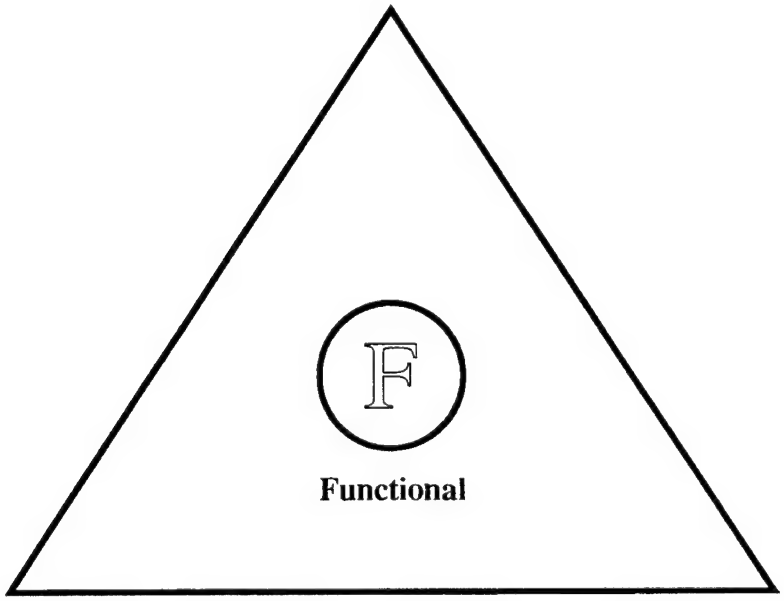

Figure M2A-1 Functional Considerations Overview.

A. OVERVIEW

Systems engineers and managers must understand a system before they can design, build, operate, and maintain it effectively and efficiently. Systems engineers and managers often enhance their understanding of a system by examining and describing a system from one or more of three system views or frames. One of the of the perspectives from which systems engineers and managers describe a system is the Functional viewpoint. One of the products of a systems analysis conducted from this perspective is a Functional Architecture. A Functional Architecture describes a system based on the functions the system must perform to meet system requirements. The purpose of this submodule is to introduce the concept of analyzing and describing systems from the Functional perspective. Some of the basic ideas covered in the assigned reading, class lectures, and class discussions of this submodule are:

1) Definition of a Function (What is a Function?)

   Work Breakdown Structure (WBS) Illustration

2) Understanding Complex Functions through Functional Decomposition

3) Recognizing Generic Patterns of Functional Architectures

   a) Work Flow Function

      Process to accomplish Work Tasks vs. Coordination Tasks

      Decomposition Criteria

         Application of Criteria

         Bottom Level is LOU or ROF

         Stopping Rules

      Effect of Technology

         Serial Processes

         Parallel Processes

      Work Flow Function viewed as a Decision Process

      Data Fusion Illustration

   b) Command and Control (C2) Function

      Control Issues

      Coordination Issues

      The Effect of Technology

      C2 viewed as a Decision Support System (DSS)

      NCA to CJTF Illustration

   c) Maintenance Function

      Goal: Sustain and Improve

         Preventative Maintenance

         Emergency Maintenance

         Incremental Growth

      The Effect of Technology

      Maintenance viewed as a DSS

d) Decision System Perspective

Problem Identification

Drivers of System Behavior

Goal Consensus

Uncertainty about Action-Outcome Relationship

Types of System Behavior

Management Science

Incremental

Carnegie

Garbage Can

Support Implications

4) Evaluating Functional Architecture Performance

a) Multiple Measures Possible

Measures Of Performance (MOP)

Measures Of Effectiveness (MOE)

Measures Of Force Effectiveness (MOFE)

b) Scales of Measurement

Top Level System Performance (TLSR) Measures

Stating Performance Requirements

Requirements Allocation

Performance and the Environment (Environmental Characteristics)

B. LEARNING OBJECTIVES

1) Understand that Functional considerations involve the functions or activities that a system must perform to satisfy system requirements.

2) Understand that Functional considerations affect and are affected by Physical and Organizational considerations.

3) Understand that two "mapping" problems exist:

   a) Mapping Functions to Physical resources.

   b) Mapping Functions onto Organizations.

C. REFERENCES

1) D. Appleton Company, Inc., *CIM Process Improvement Methodology For DoD Functional Managers*, 2d ed. (Revised and expanded), Fairfax, VA, 1993.

2) Defense Information Systems Agency, *Technical Architecture Framework for Information Management (TAFIM), Volume 1, Overview, Version 2.0,* Defense Information Systems Agency Center for Architecture, Department of Defense, Washington, D.C., November 1, 1993. pp. 27 - 33

3) Director of Space and Electronic Warfare (OP-094), *The Copernicus Architecture: Functional Description Document (FDD)*, Copernicus Project Office, Office of the CNO, Washington, D.C., August 1991.

4) Director of Space and Electronic Warfare (OP-094), *The Copernicus Architecture, Phase I: Requirements Definition,* Copernicus Project Office, Office of the CNO, Washington, D.C., August 1991.

5) Joint Staff and Services Team, *Global Command and Control Process Improvement Study (Final Draft Report),* Washington, D.C., January 15, 1993.

6) Jones, Carl R., *Functional Analysis and Allocation,* Class Notes, Naval Postgraduate School, Monterey, California, December 4, 1993.

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11) Marca, David A., and McGowen, Clement L., *SADT: Structural Analysis and Design Techniques,* McGraw-Hill Book Company, New York, 1988.

12) Moore, John, *Business Process Reengineering: The Feds Go Back to the Drawing Board,* Business Process Reengineering: The Feds Go Back to the Drawing Board, A Supplement to Federal Computer Week, September 20, 1993.

13) Operational Requirement for Naval Intelligence Processing System (NIPS) (v)4 Upgrade.

14) Page-Jones, Meilir, *A Practical Guide to Structured Systems Design,* 2nd Ed., Yourdon Press, Englewood Cliffs, New Jersey, 1988.

15) Stewart, Thomas A., *Reengineering: The Hot New Managing Tool,* Fortune, August 23, 1993.

16) The Joint Staff, *Universal Joint Task List,* Washington, D.C., October 25, 1993.

17) Waltz, Edward and Llinas, James, *Multisensor Data Fusion,* Artech House, Boston, 1990.

D. READING ASSIGNMENTS

1) Jones, Carl R., *Developing Functional Architectures,* Class Notes, Naval Postgraduate School, Monterey, California, September 13, 1992.

   Class handout.

   Read: Entire document.

2) Defense Information Systems Agency, *Technical Architecture Framework for Information Management (TAFIM), Volume 1, Overview, Version 2.0,* Defense Information Systems Agency Center for Architecture, Department of Defense, Washington, D.C., November 1, 1993.

   Class handout.

   Read: Pages 27 - 37.

3) Waltz, Edward and Llinas, James, *Multisensor Data Fusion,* Artech House, Boston, 1990.

On reserve in the library.

Peruse Chapters 1 and 2.

E. STUDY QUESTIONS

1. General Questions

1) Describe the generic patterns of Functional Architectures.

2) Provide examples of how Functional considerations affect:

   a) Physical considerations.

   b) Organizational considerations.

3) Provide examples of how Functional considerations are affected by:

   a) Physical considerations.

   b) Organizational considerations.

4) What potential problems exist with:

   a) Mapping Functions to Physical resources?

   b) Mapping Functions onto Organizations?

2. Specific Questions

See Appendix E - 5, TAFIM Volume I, Overview, Questions 7 - 9.

F. EXERCISES

None.

MODULE 2 - THE STRUCTURED APPROACH FRAMEWORK

SUBMODULE B - PHYSICAL CONSIDERATIONS

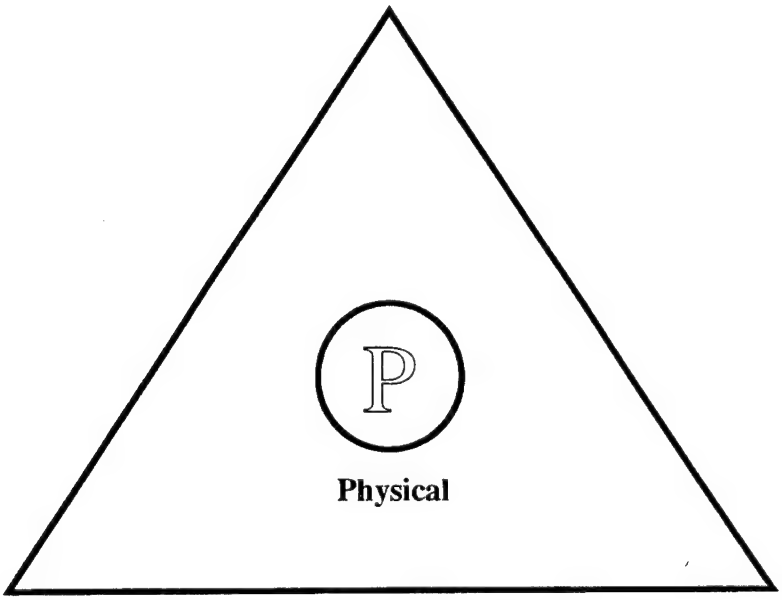

Figure M2B-1 Physical Considerations Overview.

A. OVERVIEW

Systems engineers and managers must understand a system before they can design, build, operate, and maintain it effectively and efficiently. Systems engineers and managers often enhance their understanding of a system by examining and describing a system from one or more of three system views or frames. One of the of the perspectives from which systems engineers and managers describe a system is the Physical viewpoint. One of the products of a systems analysis conducted from this perspective is a Physical Architecture. A Physical Architectures describes a system based on the physical assets and resources that the system needs to function. The purpose of this submodule is to introduce the concept of analyzing and describing systems from the Physical perspective. Some of the basic ideas covered in the assigned reading, class lectures, and class discussions of this submodule are:

1) Introduction to Physical Architectures

   Nomenclature

   Generic Models for IT from the TAFIM

      Physical Architecture Principles

      The Generic Technical Reference Model (TRM)

      The Detailed TRM and Table of Standards

2) Patterns of Physical Architectures

   Data Management View

   Communications View

   Security View

3) Humans as Physical Assets

B. LEARNING OBJECTIVES

1) Understand that Physical considerations involve the physical assets and resources that a system needs to perform system functions.

2) Understand that Physical considerations affect and are affected by Functional and Organizational considerations.

3) Understand that two "mapping" problems exist:

   a) Mapping Physical resources to Functions.

   b) Mapping Physical resources to Organizations.

C. REFERENCES

1) Blazer, Rashi, Strechel, Joel H., and Winer, Russel S., *Locally Rational Decision Making: The Distracting Effect of Information on Management on Managerial Performance,* Management Science, Vol. 38, No. 2, February 1992.

2) Defense Information Systems Agency, Technical Architecture Framework for Information Management (TAFIM), Volume 2, *Technical Reference Model and Standards Profile Summary,* Version 2.0, Defense Information Systems Agency Center for Architecture, Department of Defense, Washington, D.C., November 1, 1993.

D. READING ASSIGNMENTS

1) Defense Information Systems Agency, Technical Architecture Framework for Information Management (TAFIM), Volume 2, *Technical Reference Model and Standards Profile Summary,* Version 2.0, Defense Information Systems Agency Center for Architecture, Department of Defense, Washington, D.C., November 1, 1993.

   Class handout.

   Read: Pages 1 - 35 and 43 - 49.

E. STUDY QUESTIONS

1. General Questions

1) Describe the generic patterns of Physical Architectures.

2) Provide examples of how Physical considerations affect:

   a) Functional considerations.

   b) Organizational considerations.

3) Provide examples of how Physical considerations are affected by:

   a) Functional considerations.

   b) Organizational considerations.

4) What potential problems exist with:

   a) Mapping Physical resources to Functions?

   b) Mapping Physical resources to Organizations?

2. Specific Questions

See Appendix E - 6, TAFIM Volume II, Technical Reference Model (TRM) and Standards Profile Summary, Questions 4 - 6.

F. EXERCISES

None.

MODULE 2 - THE STRUCTURED APPROACH FRAMEWORK

SUBMODULE C - ORGANIZATIONAL CONSIDERATIONS

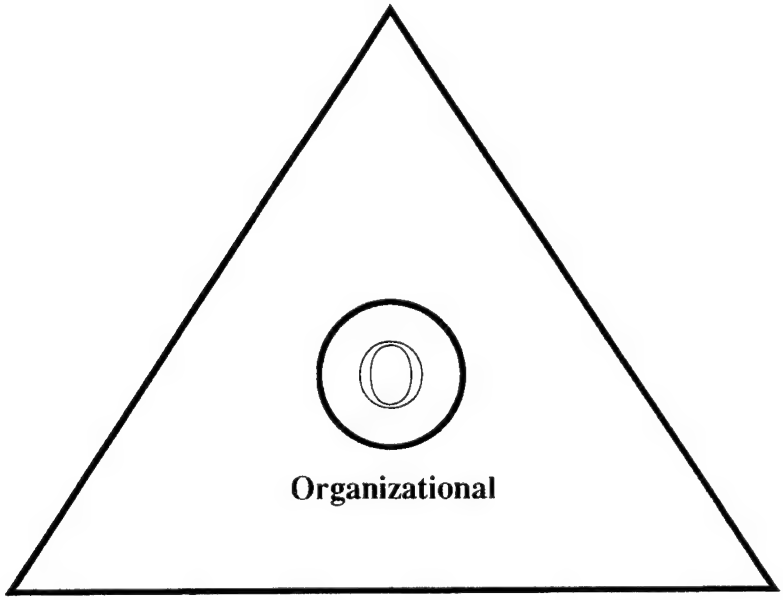

Figure M2C-1 Organizational Considerations Overview.

A. OVERVIEW

Systems engineers and managers must understand a system before they can design, build, operate, and maintain it effectively and efficiently. Systems engineers and managers often enhance their understanding of a system by examining and describing a system from one or more of three system views or frames. One of the of the perspectives from which systems engineers and managers describe a system is the Organizational viewpoint. one of the products of a systems analysis conducted from this perspective is an Organizational Architecture. An Organizational Architecture describes a system based on the way the system configures or organizes to perform system functions. The purpose of this submodule is to introduce the concept of analyzing and describing systems from the Organizational perspective. Some of the basic ideas covered in the assigned reading, class lectures, and class discussions of this submodule are:

1) Purpose of Organizational Architectures
    a) Coordinate Functions

b) Coordinate Physical Assets and Resources

2) Coordination Drivers

a) Goal Decomposition

b) Resource Allocation

c) Synchronization

d) Group Decision Making

e) Communications

f) Perception of Common Objectives

g) Dynamic Development

3) Coordinating Methods

a) Direction

b) Mutual Adjustment

c) Input Standardization

d) Process Standardization

e) Output Standardization

f) Doctrine and Standing Operating Procedures (SOP)

g) Standardization and Measurement

B. LEARNING OBJECTIVES

1) Understand that Organizational considerations involve the way(s) that a system organizes or configures to function.

2) Understand that Organizational considerations affect and are affected by Functional and Physical considerations.

3) Understand that two "mapping" problems exist:

a) Mapping Organizations to Functions.

b) Mapping Organizations to Physical resources.

C. REFERENCES

1) Blazer, Rashi, Strechel, Joel H., and Winer, Russel S., *Locally Rational Decision Making: The Distracting Effect of Information on Management on Managerial Performance,* Management Science, Vol. 38, No. 2, February 1992.

2) Bolman, Lee G. and Deal, Terrence E., *Reframing Organizations: Artistry, Choice, Leadership,* Jossey-Bass Publishers, San Francisco, 1991.

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4) Eisenhardt, Kathleen M., *Agency Theory: An Assessment and Review,* Academy of Management Review, Vol. 14, No. 1, 1989.

5) Huber, George P., *A Theory of the Effects of Advanced Technologies on Organizational Intelligence and Decision Making,* Academy of Management Review, Vol. 15, No. 1, 1990.

6) Kapasouris, P., Serfarty, D., Deckert, J.C., and Wohl, J.G., *Mapping Missions Onto C3 Organizations,* Command and Control Research Symposium (JDL), 1989.

7) Kotter, John P., *Frameworks for Analyzing Organizations,* from *Organizational Dynamics: Diagnosis and Intervention;* 1978.

8) Morgan, Gareth, *Images of Organization,* Sage Publications, Inc., Newbury Park, California, 1986,

9) Senge, Peter M., *The Fifth Discipline: The Art & Practice of the Learning Organization,* Doubleday, NY, 1990.

10) Senge, Peter M., *The Leader's New Work: Building Learning Organizations,* Sloan Management Review, Volume 32, Number 1, Fall 1990.

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12) Tichy, Noel M., *Managing Strategic Change: Technical, Political and Cultural Dynamics,* John Wiley & Sons, New York, 1983.

13) USMC, *Command and Control,* FMFM 3.

14) USMC, *Volume I: Command and Control - The Foundation,* February 23, 1994.

D. READING ASSIGNMENTS

1) USMC, *Volume I: Command and Control - The Foundation,* February 23, 1994.

   Class handout.

   Read: Entire document.

2) USMC, *Command and Control,* FMFM 3.

   Class handout.

   Read: Entire document.

E. STUDY QUESTIONS

1. General Questions

1) Describe the generic patterns of Organizational Architectures.

2) Provide examples of how Organizational considerations affect:

   a) Functional considerations.

   b) Physical considerations.

3) Provide examples of how Organizational considerations are affected by:

   a) Functional considerations.

   b) Physical considerations.

4) What potential problems exist with:

   a) Mapping Organizations to Functions?

   b) Mapping Organizations onto Physical resources?

2. Specific Questions

See Appendix E - 9, Volume I, Command and Control: The Foundation.

See Appendix E - 10, USMC FMFM-3, Command and Control.

F. EXERCISES

None.

MODULE 3 - A STRUCTURED APPROACH TO ITM IN THE DOD:

THE STRUCTURED APPROACH PROCESS

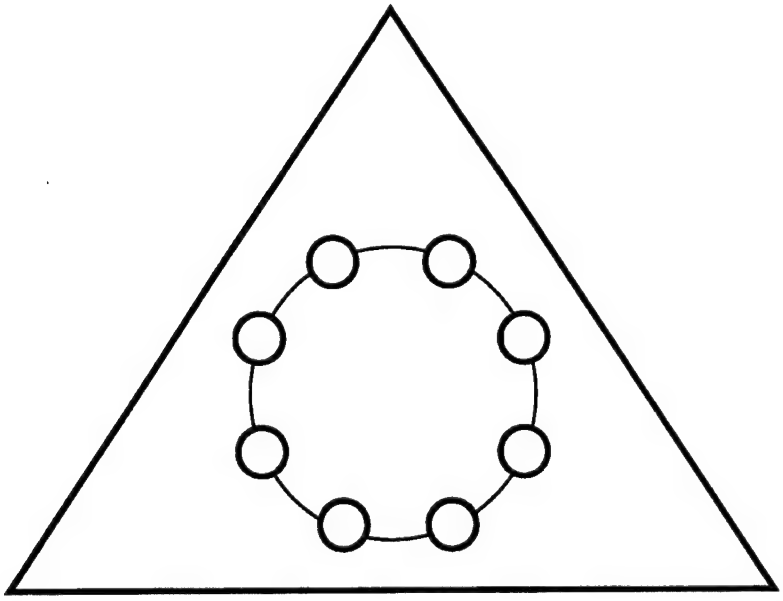

Figure M3-1 The Structured Approach Process Overview.

A. OVERVIEW

The purpose of this module is to present the dynamic part of the Structured Approach Process. This module begins with a brief introduction of the Technical Architecture Framework for Information Management (TAFIM) process for engineering and managing information systems. This module then presents an improved version of the TAFIM process called the Structured Approach Process.

Volume IV of the TAFIM, *Standards-Based Architecture Planning Guide*, presents a seven-step process for engineering and managing an information system throughout the life cycle of the system. However, the technical orientation of this process limits its usefulness. The TAFIM methodology focuses almost entirely on the Physical component of the system-in-focus, giving little attention to Functional considerations and even less attention to Organizational considerations. This narrow focus deprives systems engineers and managers of the complete system view they need to operate and maintain (evolve) the

system effectively and efficiently. The assigned reading for this module presents a brief summary of the TAFIM seven-step process. [Ref. 7]

The Structured Approach Process has eight steps as depicted in figure M3-2. A more detailed presentation of these steps follows in the eight submodules of this module. Submodule A presents the step for Organizing and Planning. Submodule B presents the step for Defining the System Problem. Submodule C presents the step for Assessing the Baseline System. Submodule D presents the step for Determining the Target Architecture. Submodule E presents the step for Developing Migration Candidates. Submodule F presents the step for Selecting the Migration Path. Submodule G presents the step for Implementing the System Plan. Submodule H presents the step for Maintaining the System Process. Each submodule provides an overview of the subject matter, learning objectives, reference material, reading assignments, study questions, and exercises for up to one week (two to four hours) of class lectures, discussions, and homework. The instructor may choose to use all, some or none of the submodules in this module, depending on the course learning objectives, the course schedule, and the student evaluation plan. Any apparent redundancies in either material or format between submodules is intentional. Redundancy increases the cohesiveness of submodules while minimizing coupling (interdependency) among submodules.

1. The Structured Approach Model

The purpose of this structured approach to systems engineering and management is to help managers design, build, operate, and maintain systems efficiently and effectively. This structured approach does this through the use of the Structured Approach Model. The Structured Approach Model provides an analytical framework for understanding and describing systems. The Structured Approach Model also provides a process for engineering and managing systems. The Structured Approach Model incorporates both a static and a dynamic view of systems. The Structured Approach Model accomplishes this through two interrelated component models: the Structured Approach Framework and the Structured Approach Process. Figure M3-2 depicts the Structured Approach Model with its two components. The Structured Approach Framework is located in the center of the Structured Approach Model (the interior). The Structured Approach Process surrounds the Structured Approach Framework (the exterior of the Structured Approach Model).

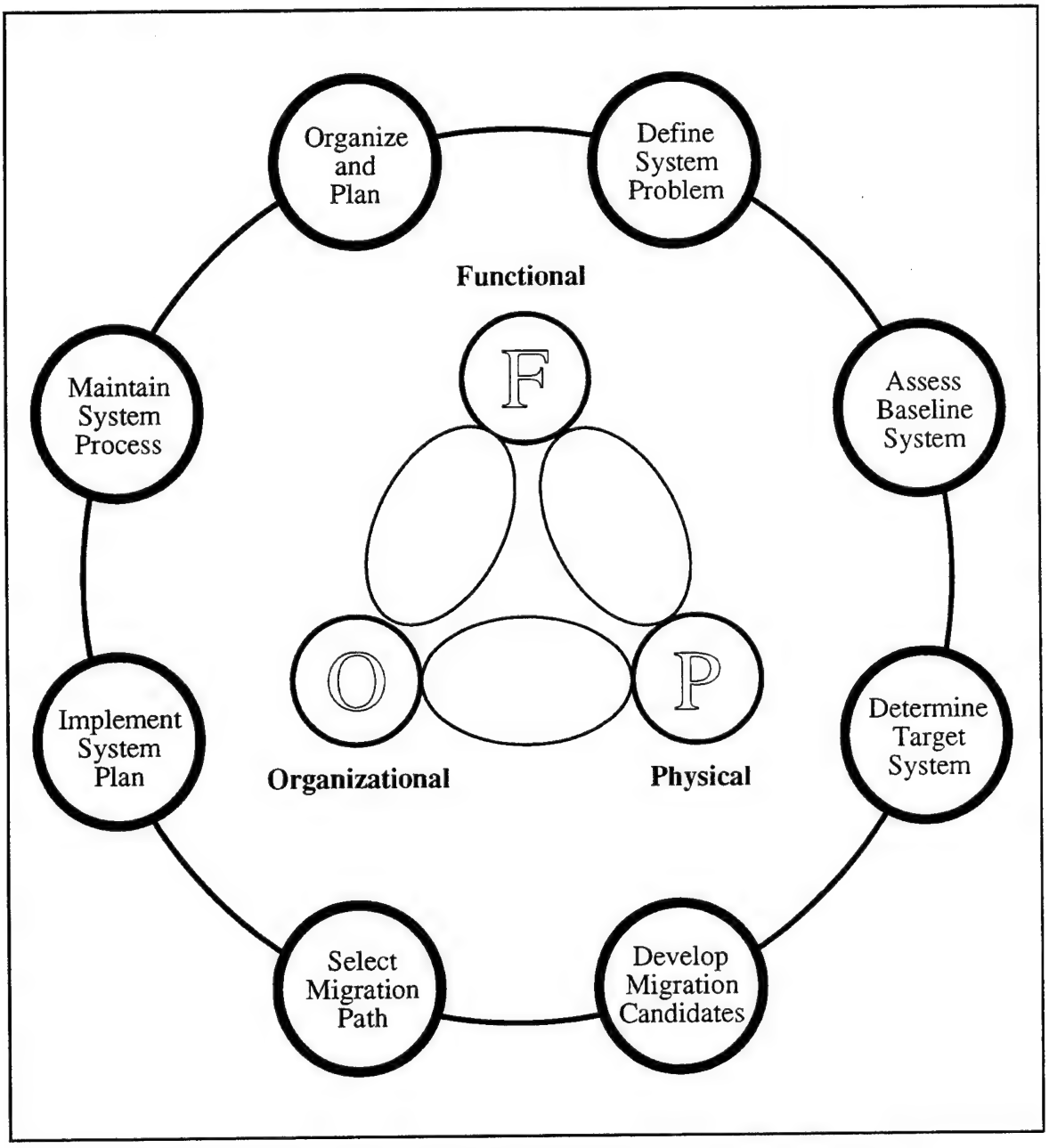

Figure M3-2 The Structured Approach Model: Framework and Process.

3. The Structured Approach Process

Effective and efficient systems engineering and management requires engineers and managers who understand the system-in-focus and can continually engineer and manage the system throughout its life cycle. This requires the use of both a static analytical framework such as the Structured Approach Framework and a dynamic process for continually improving the system over time. The Structured Approach Process is the dynamic part of the Structured Approach Model. The purpose of the Structured Approach Process is to provide system engineers and managers with a systematic way to operate and maintain a system effectively and efficiently throughout its life cycle. The Structured Approach Process does this by applying the Structured Approach Framework to eight distinct, but interrelated steps that provide a methodology for operating and evolving a system gradually and incrementally. The process begins with step 1, Organize and Plan. Once initiated, the process should not stop until the system-in-focus has reached the end of its life cycle (system termination). A brief introduction of each to the eight steps of the Structured Approach Process follows.

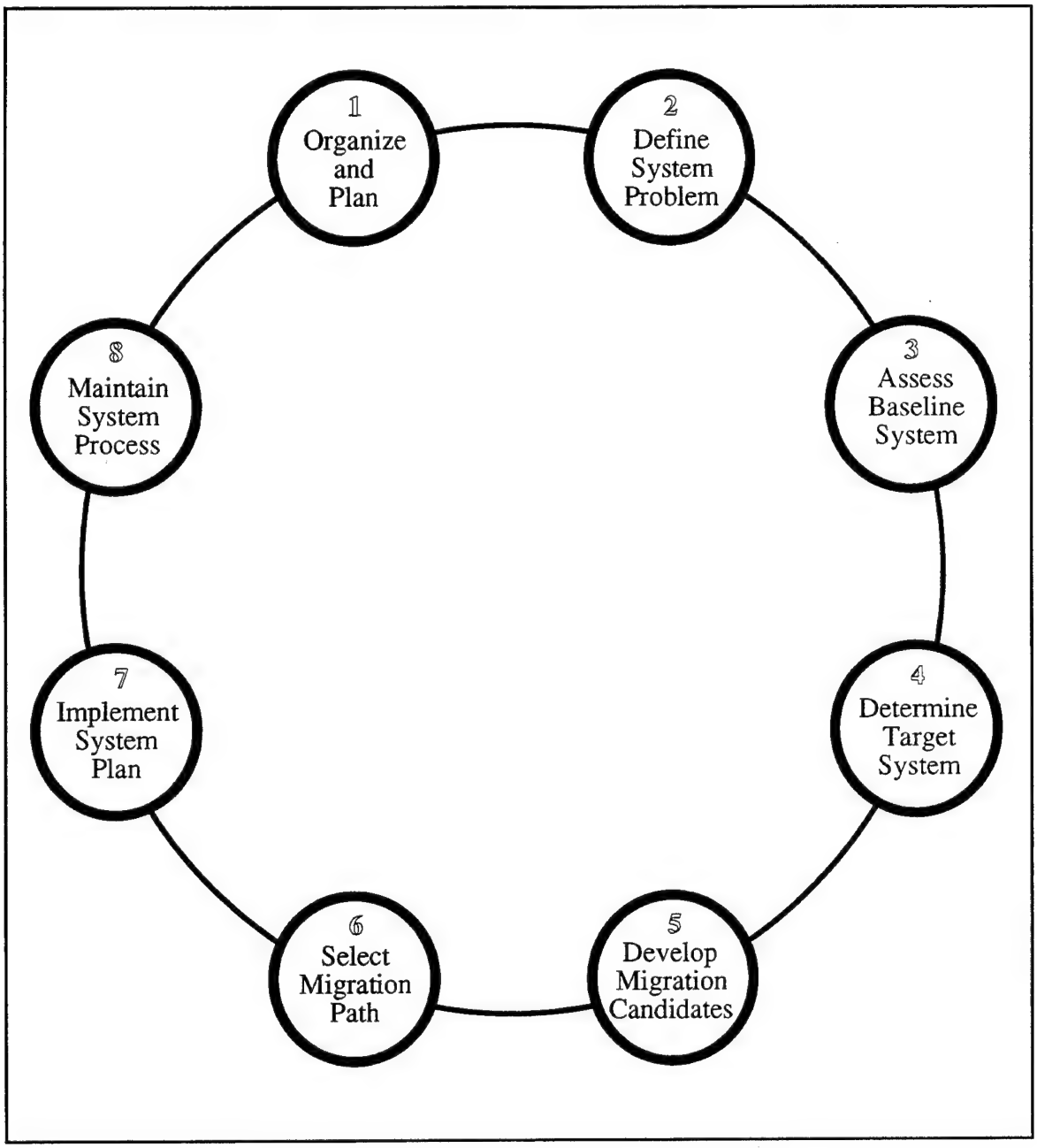

Figure M3-3 The Structured Approach Process.

1. Organizing and Planning

The first step in the Structured Approach Process is the Organize and Plan step. The purpose of this step is to develop an initial plan for the process of engineering and managing a system over time. This step in the systems engineering and management process lays the groundwork for the rest of the planning and resulting actions that follow during Structured Approach Process. [Ref. 6, Chapter 2 and Appendix I]

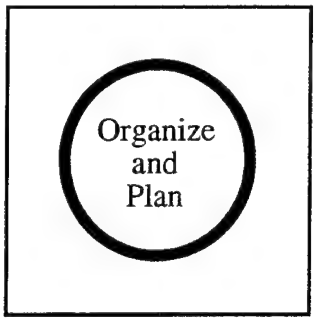

Figure M3-4 The Organizing and Planning Step of the Structured Approach Process.

The basic products of this step are:

1) Initial Executive Guidance.

2) The PURPOSE of the system-in-focus.

3) A VISION for the desired system end-state that accomplishes the PURPOSE.

4) An initial PLAN for achieving the VISION.

5) Initial Executive Approval and Support.

The PURPOSE, VISION, and PLAN should incorporate all three views of the Structured Approach Framework: Functional, Physical, and Organizational. Submodule A introduces this step of the Structured Approach Process.

2. Defining the System Problem

The second step in the Structured Approach Process is the Define the System Problem step. The purpose of this step is to structure the system problem so that all subsequent engineering and management efforts will be both effective *(doing the right thing)* and efficient *(doing things right).* [Ref. 7] This step in the systems engineering and

management process bounds the problem and enables systems engineers and managers to focus on the most important issues and problems. [Ref. 8]

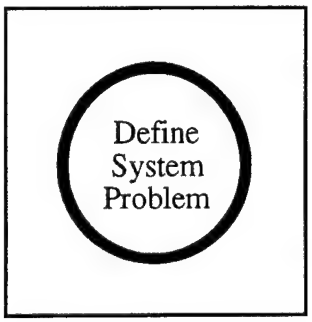

Figure M3-5 The System Problem Definition Step of the Structured Approach Process.

The basic product of this step is a Formal System Problem Statement. The Formal System Problem Statement should incorporate all three views of the Structured Approach Framework: Functional, Physical, and Organizational. Submodule B introduces this step of the Structured Approach Process.

3. Assessing the Baseline System

The third step in the Structured Approach Process is the Baseline System Assessment step. The purpose of this step is to determine the character and state of the current system. This step in the systems engineering and management process lays the foundation for future planning and actions in the process of evolving the system. [Ref. 6, Chapter 3 and Appendix II]

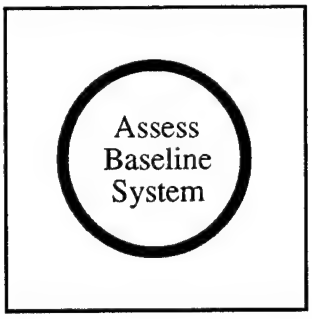

Figure M3-6 The Baseline System Assessment Step of the Structured Approach Process.

The basic product of this step is the Baseline System Architecture. The Baseline System Architecture serves as a benchmark or departure point for implementing changes to

the system-in-focus. The Baseline Architecture should incorporate all three views of the Structured Approach Framework: Functional, Physical, and Organizational. Submodule C introduces this step of the Structured Approach Process.

4. Determining the Target System

The fourth step in the Structured Approach Process is the Target System Determination step. The purpose of this step is to determine the character and state of the desired (future) system. The Target Architecture usually describes the system-in-focus three to five years into the future. [Ref. 6, Chapter 4 and Appendix III]

Figure M3-7 The Target System Determination Step of the Structured Approach Process.

The basic product of this step is the Target System Architecture. The Target Architecture should describe the future system using the three views of the Structured Approach Framework: Functional, Physical, and Organizational. Submodule D introduces this step of the Structured Approach Process.

5. Developing Migration Candidates

The fifth step in the Structured Approach Process is the Develop Migration Candidate Development step. The purpose of this step is to develop several possible ways (plans, hardware, software, technical and managerial support, etc.) to migrate the existing (Baseline) system-in-focus toward the Target Architecture. [Ref. 6, Chapters 5 and 6 and Appendix V]

Figure M3-8 Migration Candidate Development Step of the Structured Approach Process.

The basic product of this step is a set of Migration Candidates. Each of the migration candidates should be described using all three views of the Structured Approach Framework: Functional, Physical, and Organizational. Submodule E introduces this step of the Structured Approach Process.

6. Selecting the Migration Path

The sixth step in the Structured Approach Process is the Migration Path Selection step. The purpose of this step is to select the best way or combination of ways (plans, hardware, software, technical and managerial support, etc.) to migrate the existing (Baseline) system-in-focus toward the Target Architecture. [Ref. 6, Chapter 6 and Appendix VI]

Figure M3-9 The Migration Path Selection Step of the Structured Approach Process.

The basic product of this step is a System Migration Plan or Path. The description of the selected migration candidate should incorporate all three views of the Structured Approach Framework: Functional, Physical, and Organizational. Submodule F introduces this step of the Structured Approach Process.

7. Implementing the System Plan

The seventh step in the Structured Approach Process is the Implement the System Plan Implementation step. The purpose of this step is to execute the Systems Migration Plan that migrates the existing (Baseline) system-in-focus toward the Target Architecture. [Ref. 6, Chapter 7]

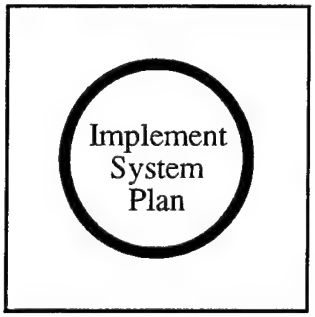

Figure M3-10 The System Plan Implementation Step of the Structured Approach Process.

The basic product of this step is an evolving system (Baseline system moving toward the Target) and a set of lessons learned from implementing the System Migration Plan. The implementation plan should address all three views of the Structured Approach Framework: Functional, Physical, and Organizational. Submodule G introduces this step of the Structured Approach Process.

8. Maintaining the System Process

The eighth and final step in the Structured Approach Process is the Maintain the System Process Maintenance step. The purpose of this step is to maintain the Structured Approach Process itself. Users of the Structured Approach Process must include this step to ensure that the methodology continues to help systems engineers and managers operate and maintain (evolve) the system-in-focus effectively and efficiently throughout the life cycle of the system. [Ref. 6, Chapter 8 and Appendix VIII]

Figure M3-11 The System Process Maintenance Step of the Structured Approach Process.

The basic product of this step is a well-maintained process for engineering and managing the system-in-focus. Maintaining the system process requires viewing the entire Structured Approach Process using the Structured Approach Framework to determine which steps of the process require adjustment. Submodule H introduces this step of the Structured Approach Process.

B. LEARNING OBJECTIVES

1) Understand the need for a systematic process for engineering and managing a system throughout its life cycle.

2) Understand the need to apply the Structured Approach Framework to view each step of the Structured Approach Process as well to view the Structured Approach Process as a whole.

3) Understand the process involved in each of the individual steps in the Structured Approach Process and how each step contributes to the overall (whole) process.

C REFERENCES

1) Air Force Deputy Chief of Staff, *Horizon: Air Force C4I Strategy for the 21st Century,* C4I Plans and Policy Division, The Pentagon, Washington, D.C.

2) Anderson, David R., Sweeney, Dennis J., and Williams, Thomas A., *An Introduction to Management Science: Quantitative Approaches to Decision Making,* 6th Ed., West Publishing Company, St. Paul, Minnesota, 1991.

3) Assistant Secretary of Defense, Command, Control, Communications, and Intelligence (C3I), *Corporate Information Management for the 21st Century: A DoD Strategic Plan,* U.S. Department of Defense, Washington, D.C., June 1994.

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Migration Prototyping Project, Decision Briefing for Emmett Paige, Jr., Washington, D.C., February 9, 1994.

5) Beer, Michael, Eisenstat, Russell A., and Spector, Bert, *Why Change Programs Don't Produce Change*, Harvard Business Review, November - December 1990.

6) Bryant, Don, *The Psychology of Resistance to Change*, Management Services, March, 1979.

7) Chairman of the Joint Chiefs of Staff, *C4I For The Warrior,* The Joint Staff, the Pentagon, Washington, D.C., June 12, 1992.

8) Chevrier, John, *What is JMCIS?*, Naval Command, Control and Ocean Surveillance Center, RDT&E Division, November 17, 1993.

9) Collins, James C. and Porras, Jerry I., *A Framework for Setting Corporate Vision,* Stanford University Graduate School of Business, March 2, 1991.

10) Command and Control Systems Architecture and Engineering Program Office, *Battle Management Architecture Design Concepts,* Naval Ocean Systems Center, San Diego, California, August 1991.

11) Covey, Stephen R., *The 7 Habits of Highly Effective People: Powerful Lessons in Personal Change,* Simon & Shuster, New York, 1989.

12) Defense Information Systems Agency, *CIM Functional Economic Analysis Guidebook*, Version 1.0, Arlington, VA, January 15, 1993.

13) Defense Information Systems Agency, *Global Command and Control System (GCCS),* Department of Defense, Washington, D.C.

14) Defense Information Systems Agency, *Technical Architecture Framework for Information Management (TAFIM), Volume 1, Overview, Version 2.0,* Defense Information Systems Agency Center for Architecture, Department of Defense, Washington, D.C., November 1, 1993.

15) Defense Information Systems Agency, *Technical Architecture Framework for Information Management (TAFIM), Volume 3, Architecture Concepts and Design Guidance, Version 2.0,* Defense Information Systems Agency Center for Architecture, Department of Defense, Washington, D.C., November 1, 1993.

16) Defense Information Systems Agency, *Technical Architecture Framework for Information Management (TAFIM), Volume 4, Standards-Based Architecture Planning Guide, Version 2.0,* Defense Information Systems Agency Center for Architecture, Department of Defense, Washington, D.C., October 25, 1993.

17) Department of Defense Directive, DODD 4630.5, Subject: Compatibility, Interoperability, and Integration of Command, Control, Communications, and Intelligence (C3I) Systems, November 19, 1992.

18) Department of Defense Instruction, DODD 4630.8, Subject: Procedures for Compatibility, Interoperability, and Integration of Command, Control, Communications, and Intelligence (C3I) Systems, November 18, 1992.

19) Department of the Army, *The Vision: The Army Enterprise Strategy,* Department of Defense, Washington, D.C., 1993.

20) Director of Command, Control, Communications, and Computer Systems, J-6, *Committed, Focused, and Needed, C4I For The Warrior,* The Joint Staff, Department of Defense, Washington, D.C., June 12, 1993.

21) Director of Space and Electronic Warfare (OP-094), *Copernicus* Information Pamphlet, Copernicus Project Team Director, Office of the CNO, Washington, D.C.

22) Director of Space and Electronic Warfare (OP-094), *Sonata* Information Pamphlet (Copernicus Background Information), Copernicus Project Team Director, Office of the CNO, Washington, D.C.

23) Director of Space and Electronic Warfare (OP-094), *The Copernicus Architecture: Functional Description Document (FDD),* Copernicus Project Office, Office of the CNO, Washington, D.C., August 1991.

24) Director of Space and Electronic Warfare (OP-094), *The Copernicus Architecture, Phase I: Requirements Definition,* Copernicus Project Office, Office of the CNO, Washington, D.C., August 1991.

25) Egge, Daniel Q., A Framework for Evaluating Evolutionary Upgrade Paths of Command, Control, and Communications Systems, M.S. Thesis, Naval Postgraduate School, Monterey, California, June 1993.

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27) Hammer, Michael, *Reengineering Work: Don't Automate, Obliterate,* Harvard Business Review, July - August 1990.

28) Hammer, Michael and Champy, James, *Reengineering the Corporation: A Manifesto For Business Revolution,* Harper-Collins Publishers, Inc., NY, 1990.

29) Intelligence and Communications Architecture (INCA), *Assessment of New and Emerging Communications Technologies,* December 22, 1993.

30) Intelligence and Communications Architecture (INCA), *Intelligence and Communications Support to a Deployed Joint Task Force (JTF): A Goal Intelligence and Communications Architecture (GICA),* October, 1993.

31) Jones, Carl R., *The System Engineering Decision Problem,* Class Notes, Naval Postgraduate School, Monterey, California, May 31, 1993.

32) Jones, Carl R., *The System Engineering Formal Decision Problem,* Class Notes, Naval Postgraduate School, Monterey, California, December 4, 1993.

33) Jones, Carl R., *Cost, Risk Analysis and Selection,* Class Notes, Naval Postgraduate School, Monterey, California, December 5, 1993.

34) Kahan, James P., Worley, D. Robert, Stasz, Cathleen, *Understanding Commanders' Information Needs,* Arroyo Center, The RAND Corporation, Santa Monica, California.

35) Kahmenucur, Daniel and Lovalls, *Timed Choices and Bold Forecasts: A Logical Perspective on Risk Taking,* Management Science, Vol. 3, No. 1, January 1993.

36) Kotter, John P. and Schlesinger, Leonard A., *Choosing Strategies For Change*, from *Management Of Change*, a forthcoming Dow Jones - Irwin book.

37) Light, Paul, *Surviving Reinvention*, Management Focus, Government Executive, June 1994.

38) Loveless, Bruce L., *An Architectural Approach to Strategic Information System Planning for the Office of Naval Intelligence,* M.S. Thesis, Naval Postgraduate School, Monterey, California, September 1994.

39) Loveless, B., Sweeny, T., Weatherford, M., *JMCIS and Naval Information Systems Migration*, Briefing Slides, Naval Postgraduate School, Monterey, California, May 1994.

40) Marca, David A., and McGowen, Clement L., *SADT: Structural Analysis and Design Techniques,* McGraw-Hill Book Company, New York, 1988.

41) Mechling, Jerry, *Reengineering Tips for Federal Managers*, Business Process Reengineering: The Feds Go Back to the Drawing Board, A Supplement to Federal Computer Week, September 20, 1993.

42) Poza, Ernesto J. and Markus, M. Lynne, *Success Story: The Team Approach to Work Restructuring,* Organizational Dynamics, Winter 1980.

43) Sessions, Sterling D. and Jones, Carl R., *Interoperability: A Desert Storm Case Study,* Institute for National Strategic Studies, National Defense University, Washington, D.C., July 1993.

44) Spegele, Joseph B., *A Framework for Evaluating Application of Smart Cards and Related Technology within the Department of Defense,* M.S. Thesis, Naval Postgraduate School, Monterey, California, September 1994.

45) Tichy, Noel M., *Managing Strategic Change: Technical, Political and Cultural Dynamics,* John Wiley & Sons, New York, 1983.

46) Walsh, Edward J., *Navy Aims at Joint operations Roles and Economies for C4I,* Navy / Industry Technology Partnership, Sea Power, April 1994.

47) Zahedi, Fatemah, *The Analytical Hierarchy Process: A Survey of the Method and Its Applications,* Interfaces, 16:4, July-August 1986.

D. READING ASSIGNMENTS

1) Loveless, Bruce L., *An Architectural Approach to Strategic Information System Planning for the Office of Naval Intelligence,* M.S. Thesis, Naval Postgraduate School, Monterey, California, September 1994.

   Class handout.

   Read: Pages 9 - 41.

2) Recommended, but optional:

   a) Defense Information Systems Agency, Technical Architecture Framework for Information Management (TAFIM), Volume 4, *Standards-Based Architecture Planning Guide,* Version 2.0, Defense Information Systems Agency Center for Architecture, Department of Defense, Washington, D.C., October 25, 1993.

      On reserve in the library.

      Read: Preface, Forward, and Chapter 1.

   b) Logan, Paul R., *The Department of Defense Technical Architecture Framework for Information Management: Necessary, But NOT Sufficient,* IS4182 Essay, Naval Postgraduate School, Monterey, California, September 15, 1994.

      On reserve in the library.

      Read: Entire document.

E. STUDY QUESTIONS

1. General Questions

1) Why is it important to have a systematic process for engineering and managing a system throughout its life cycle?

2) What are the principal benefits of using the Structured Approach Framework in each step of the Structured Approach Process?

3) What occurs in each step of the Structured Approach Process?

4) How does each step of the Structured Approach Process contribute to the overall process?

2. Specific Questions

Specific study questions are listed in this section of each submodule in this module, when applicable.

F. EXERCISES

The course instructor may assign exercises from the assigned reading to reinforce student learning of the material presented in the assigned readings, class lectures, and class discussions.

MODULE 3 - THE STRUCTURED APPROACH PROCESS

SUBMODULE A - ORGANIZING AND PLANNING

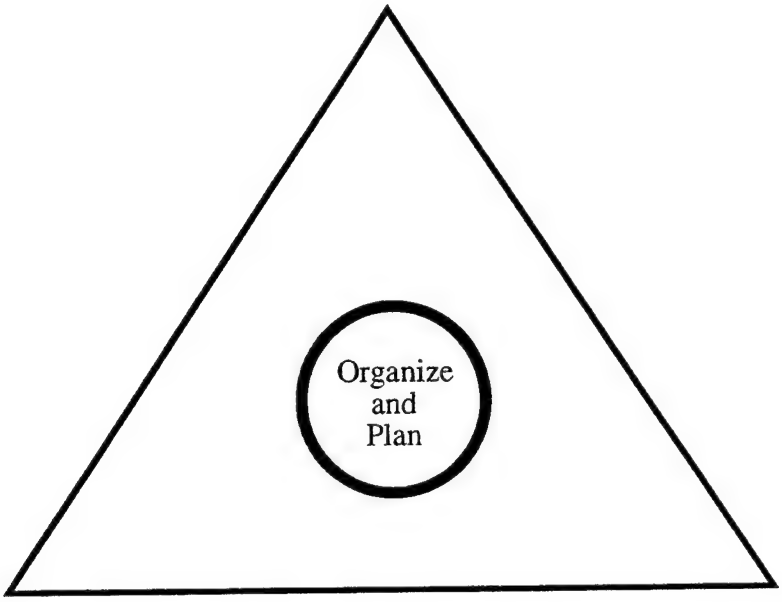

Figure M3A-1 Organizing and Planning Overview.

A. OVERVIEW

The first step in the Structured Approach Process is the Organizing and Plan step. The purpose of this step is to develop an initial plan for the process of engineering and managing a system over time. This step in the systems engineering and management process lays the groundwork for the planning and actions that occur throughout the Structured Approach Process. [Ref. 6, Chapter 2 and Appendix I]

The basic products of this step are:

1) Initial Executive Guidance.

2) The PURPOSE for applying the Structured Approach Model to the system-in-focus.

3) A VISION for the desired system end-state that accomplishes the PURPOSE.

4) An initial PLAN for achieving the VISION.

5) Initial Executive Approval and Support.

The PURPOSE, VISION, and PLAN should all incorporate the three views of the Structured Approach Framework: Functional, Physical, and Organizational.

Committed, Focused, and Needed, C4I For The Warrior published by the Director of Command, Control, Communications, and Computer Systems, J-6, The Joint Staff, establishes the VISION for IT in the DoD. Other examples of VISION for IT include:

1) Assistant Secretary of Defense, Command, Control, Communications, and Intelligence (C3I), *Corporate Information Management for the 21st Century: A DoD Strategic Plan,* U.S. Department of Defense, Washington, D.C., June 1994.

2) Air Force Deputy Chief of Staff, *Horizon: Air Force C4I Strategy for the 21st Century,* C4I Plans and Policy Division, The Pentagon, Washington, D.C.

B. LEARNING OBJECTIVES

1) Understand the need for and significance of establishing a PURPOSE for the system-in-focus and for applying the Structured Approach Model to the system. The PURPOSE answers the basic questions, "What does the system do?" and "Why do we need to apply the Structured Approach Model to this system?"

2) Understand the need for and significance of creating a VISION describing the future system-in-focus and the desired result of applying the Structured Approach Model to the system.

3) Understand the need to have an overall PLAN for managing the Structured Approach Process.

4) Understand the benefit of applying the Structured Approach Framework to develop a better system PURPOSE, VISION, and Structured Approach management PLAN.

C. REFERENCES

1) Air Force Deputy Chief of Staff, *Horizon: Air Force C4I Strategy for the 21st Century,* C4I Plans and Policy Division, The Pentagon, Washington, D.C.

2) Assistant Secretary of Defense, Command, Control, Communications, and Intelligence (C3I), *Corporate Information Management for the 21st Century: A DoD Strategic Plan,* U.S. Department of Defense, Washington, D.C., June 1994.

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4) Collins, James C. and Porras, Jerry I., *A Framework for Setting Corporate Vision,* Stanford University Graduate School of Business, March 2, 1991.

5) Defense Information Systems Agency, *Technical Architecture Framework for Information Management (TAFIM), Volume 1, Overview, Version 2.0,* Defense Information Systems Agency Center for Architecture, Department of Defense, Washington, D.C., November 1, 1993.

6) Defense Information Systems Agency, *Technical Architecture Framework for Information Management (TAFIM), Volume 4, Standards-Based Architecture Planning Guide, Version 2.0,* Defense Information Systems Agency Center for Architecture, Department of Defense, Washington, D.C., October 25, 1993.

7) Department of Defense Directive, DODD 4630.5, Subject: Compatibility, Interoperability, and Integration of Command, Control, Communications, and Intelligence (C3I) Systems, November 19, 1992.

8) Department of Defense Instruction, DODD 4630.8, Subject: Procedures for Compatibility, Interoperability, and Integration of Command, Control, Communications, and Intelligence (C3I) Systems, November 18, 1992.

9) Director of Command, Control, Communications, and Computer Systems, J-6, *Committed, Focused, and Needed, C4I For The Warrior,* The Joint Staff, Department of Defense, Washington, D.C., June 12, 1993.

10) Loveless, Bruce L., *An Architectural Approach to Strategic Information System Planning for the Office of Naval Intelligence,* M.S. Thesis, Naval Postgraduate School, Monterey, California, September 1994.

D. READING ASSIGNMENTS

1) Director of Command, Control, Communications, and Computer Systems, J-6, *Committed, Focused, and Needed, C4I For The Warrior,* The Joint Staff, Department of Defense, Washington, D.C., June 12, 1993.

   Class handout.

   Read: Entire document.

2) Defense Information Systems Agency, *Technical Architecture Framework for Information Management (TAFIM), Volume 1, Overview, Version 2.0,* Defense Information Systems Agency Center for Architecture, Department of Defense, Washington, D.C., November 1, 1993.

   Class handout.

   Read: Pages 11 - 25.

3) Loveless, Bruce L., *An Architectural Approach to Strategic Information System Planning for the Office of Naval Intelligence,* M.S. Thesis, Naval Postgraduate School, Monterey, California, September 1994.

   Class handout.

   Read: Pages 42 - 62.

4) Recommended, but optional:

   a) Defense Information Systems Agency, *Technical Architecture Framework for Information Management (TAFIM), Volume 4, Standards-Based Architecture Planning Guide, Version 2.0,* Defense Information Systems Agency Center for Architecture, Department of Defense, Washington, D.C., October 25, 1993.

      On reserve in the NPS library.

      Read: Chapter 2 and Appendix I.

   b) Assistant Secretary of Defense, Command, Control, Communications, and Intelligence (C3I), *Corporate Information Management for the 21st Century: A DoD Strategic Plan,* U.S. Department of Defense, Washington, D.C., June 1994.

      On reserve in the NPS library.

      Read: Entire document.

   c) Air Force Deputy Chief of Staff, *Horizon: Air Force C4I Strategy for the 21st Century,* C4I Plans and Policy Division, The Pentagon, Washington, D.C.

      On reserve in the NPS library.

      Read: Entire document.

E. STUDY QUESTIONS

1. General Questions

1) Explain the need for and significance of establishing a PURPOSE for both the system-in-focus and for applying the Structured Approach Model to the system.

2) Explain the need for and significance of creating a VISION describing the future system-in-focus and the desired result of applying the Structured Approach Model to the system.

3) Explain the need to have an overall PLAN for managing the Structured Approach Process.

4) Explain the benefit of applying the Structured Approach Framework to develop a better description of the system PURPOSE, VISION, and Structured Approach Management PLAN.

2. Specific Questions

Optional: See Appendix E - 5, TAFIM Volume I, Questions 4 - 6.

F. EXERCISES

None.

MODULE 3 - THE STRUCTURED APPROACH PROCESS

SUBMODULE B - DEFINING THE SYSTEM PROBLEM

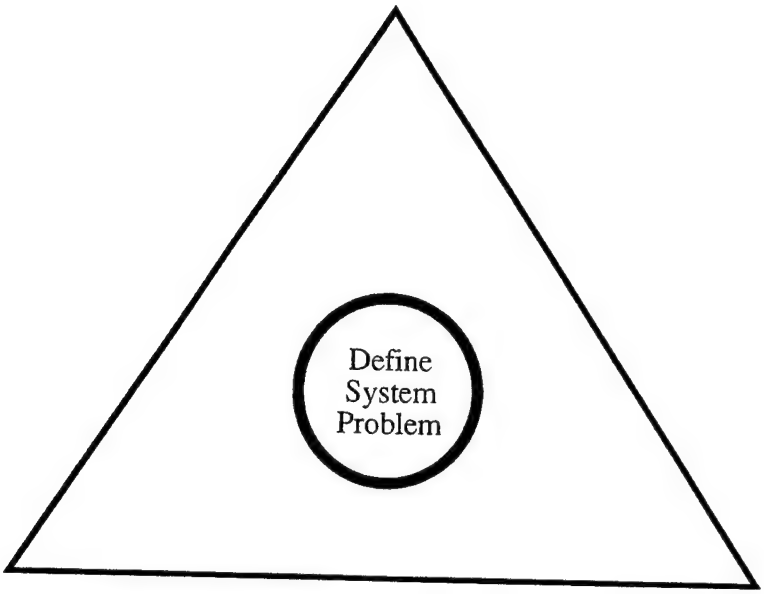


Figure M3B-1 Defining The System Problem Overview.

A. OVERVIEW

The second step in the Structured Approach Process is the System Problem Definition step. The purpose of this step is to structure the system problem so that all subsequent engineering and management efforts will be both effective *(doing the right thing)* and efficient *(doing things right)*. [Ref. 7] This step in the systems engineering and management process bounds the problem and enables systems engineers and managers to focus on the most important issues and problems. The basic product of this step is a Formal System Problem Statement. The Formal System Problem Statement should incorporate all three views of the Structured Approach Framework: Functional, Physical, and Organizational. [Ref. 8]

B. LEARNING OBJECTIVES

1) Understand the importance of defining the system problem before proceeding with the rest of the Structured Approach Process.

2) Understand the benefit of defining the system problem using the three views of the Structured Approach Framework.

C. REFERENCES

1) Jones, Carl R., *The System Engineering Formal Decision Problem*, Class Notes, Naval Postgraduate School, Monterey, California, December 4, 1993.

D. READING ASSIGNMENTS

1) Jones, Carl R., *The System Engineering Formal Decision Problem*, Class Notes, Naval Postgraduate School, Monterey, California, December 4, 1993.

   Class handout.

   Read: Pages 1 - 37 (stop at Selection material).

E. STUDY QUESTIONS

1. General Questions

1) Why is it important to define the system problem before proceeding with the rest of the Structured Approach Process?

2) What are the benefits of defining the system problem using the three views of the Structured Approach Framework?

2. Specific Questions

None.

F. EXERCISES

None.

MODULE 3 - THE STRUCTURED APPROACH PROCESS

SUBMODULE C - ASSESSING THE BASELINE SYSTEM

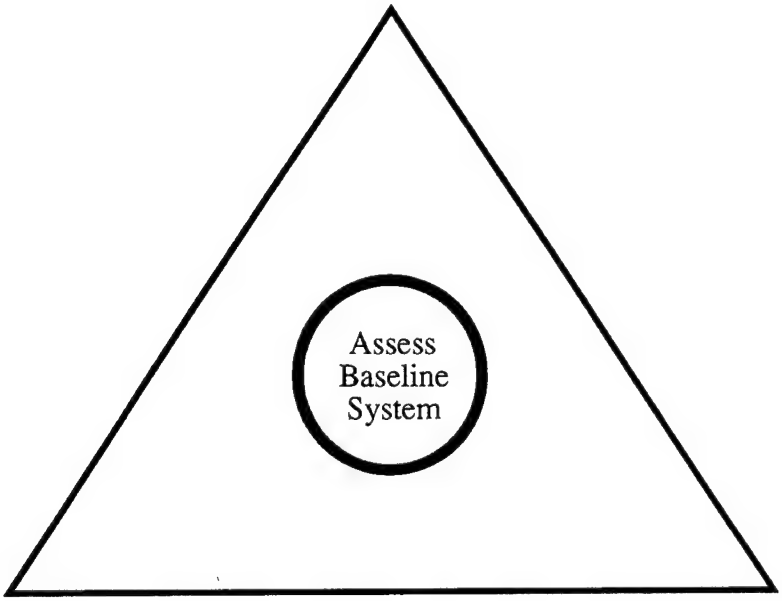


Figure M3C-1 Assessing The Baseline System Overview.

A. OVERVIEW

The third step in the Structured Approach Process is the Baseline System Assessment step. The purpose of this step is to determine the character and state of the current system. This step in the systems engineering and management process lays the foundation for future planning and actions that follow in the process of evolving the system. The basic product of this step is the Baseline System Architecture. The Baseline System Architecture serves as a benchmark or departure point for implementing changes to the system-in-focus. The Baseline Architecture should incorporate all three views of the Structured Approach Framework: Functional, Physical, and Organizational. [Ref. 6, Chapter 3 and Appendix II]

B. LEARNING OBJECTIVES

1) Understand the need to assess the baseline system before proceeding with the rest of the Structured Approach Process.

2) Understand the benefit of describing the system-in-focus using the Structured Approach Framework.

C. REFERENCES

1) Defense Information Systems Agency, Technical Architecture Framework for Information Management (TAFIM), Volume 3, *Architecture Concepts and Design Guidance,* Version 2.0, Defense Information Systems Agency Center for Architecture, Department of Defense, Washington, D.C., November 1, 1993.

2) Defense Information Systems Agency, Technical Architecture Framework for Information Management (TAFIM), Volume 4, *Standards-Based Architecture Planning Guide,* Version 2.0, Defense Information Systems Agency Center for Architecture, Department of Defense, Washington, D.C., October 25, 1993.

3) Freeman, Roger L., *Telecommunication Transmission Handbook,* 3rd Ed., John Wiley and Sons, Inc., New York, 1991.

4) Loveless, Bruce L., An Architectural Approach to Strategic Information System Planning for the Office of Naval Intelligence, M.S. Thesis, Naval Postgraduate School, Monterey, California, September 1994.

5) Marca, David A., and McGowen, Clement L., *SADT: Structural Analysis and Design Techniques,* McGraw-Hill Book Company, New York, 1988.

6) Sessions, Sterling D. and Jones, Carl R., *Interoperability: A Desert Storm Case Study,* Institute for National Strategic Studies, National Defense University, Washington, D.C., July 1993.

D. READING ASSIGNMENTS

1) Defense Information Systems Agency, Technical Architecture Framework for Information Management (TAFIM), Volume 3, *Architecture Concepts and Design Guidance,* Version 2.0, Defense Information Systems Agency Center for Architecture, Department of Defense, Washington, D.C., November 1, 1993.

   Class handout.

   Read: Pages 3 - 32.

2) Loveless, Bruce L., *An Architectural Approach to Strategic Information System Planning for the Office of Naval Intelligence,* M.S. Thesis, Naval Postgraduate School, Monterey, California, September 1994.

   Class handout.

   Read: Pages 63 - 83.

3) Recommended, but optional:

   a) Defense Information Systems Agency, *Technical Architecture Framework for Information Management (TAFIM), Volume 4, Standards-Based Architecture Planning Guide, Version 2.0,* Defense Information Systems Agency Center for Architecture, Department of Defense, Washington, D.C., October 25, 1993.

      On reserve in the NPS library.

      Read: Chapter 3 and Appendix II.

   b) Other materials on reserve in the NPS library.

E. STUDY QUESTIONS

1. General Questions

1) Why is it important to assess the baseline system before proceeding with the rest of the Structured Approach Process?

2) What are the benefits of describing the system-in-focus using the Structured Approach Framework?

2. Specific Questions

See Appendix E - 7, TAFIM Volume III, Questions 1 - 21.

F. EXERCISES

Select a DoD information system of your choice.

Do a Baseline Assessment of your system-in-focus using the Structured Approach Framework.

Group Project (project teams).

Report length: ≤ 50 pages including appendices.

Suspense IAW Appendix B, Course Schedule.

MODULE 3 - THE STRUCTURED APPROACH PROCESS

SUBMODULE D - DETERMINING THE TARGET SYSTEM

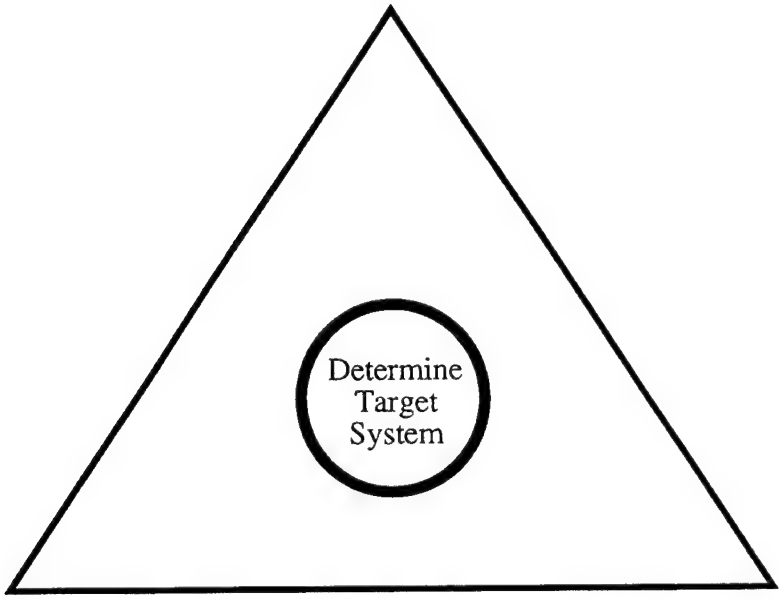


Figure M3D-1 Determining The Target System Overview.

A. OVERVIEW

The fourth step in the Structured Approach Process is the Target System Determination step. The purpose of this step is to determine the character and state of the desired (future) system. The Target Architecture usually describes the system-in-focus three to five years into the future. The basic product of this step is the Target System Architecture. The Target Architecture should describe the future system using the three views of the Structured Approach Framework: Functional, Physical, and Organizational. [Ref. 6, Chapter 4 and Appendix III]

Three documents which contain good examples of Target Architectures are:

1) Director of Space and Electronic Warfare (OP-094), *Copernicus* Information Pamphlet, Copernicus Project Team Director, Office of the CNO, Washington, D.C.

2) Department of the Army, *The Vision: The Army Enterprise Strategy*, Department of Defense, Washington, D.C., 1993.

3) Intelligence and Communications Architecture (INCA), *Intelligence and Communications Support to a Deployed Joint Task Force (JTF): A Goal Intelligence and Communications Architecture (GICA),* October, 1993.

B. LEARNING OBJECTIVES

1) Understand the importance of determining a target for the system-in-focus.

2) Understand the benefit of describing the target system using the Structured Approach Framework.

C. REFERENCES

1) Chevrier, John, *What is JMCIS?,* Naval Command, Control and Ocean Surveillance Center, RDT&E Division, November 17, 1993.

2) Command and Control Systems Architecture and Engineering Program Office, *Battle Management Architecture Design Concepts,* Naval Ocean Systems Center, San Diego, California, August 1991.

3) Defense Information Systems Agency, *Global Command and Control System (GCCS),* Department of Defense, Washington, D.C.

4) Defense Information Systems Agency, *Technical Architecture Framework for Information Management (TAFIM), Volume 3, Architecture Concepts and Design Guidance, Version 2.0,* Defense Information Systems Agency Center for Architecture, Department of Defense, Washington, D.C., November 1, 1993.

5) Defense Information Systems Agency, *Technical Architecture Framework for Information Management (TAFIM), Volume 4, Standards-Based Architecture Planning Guide, Version 2.0,* Defense Information Systems Agency Center for Architecture, Department of Defense, Washington, D.C., October 25, 1993.

6) Department of the Army, *The Vision: The Army Enterprise Strategy,* Department of Defense, Washington, D.C., 1993.

7) Director of Space and Electronic Warfare (OP-094), *Copernicus* Information Pamphlet, Copernicus Project Team Director, Office of the CNO, Washington, D.C.

8) Director of Space and Electronic Warfare (OP-094), *Sonata* Information Pamphlet (Copernicus Background Information), Copernicus Project Team Director, Office of the CNO, Washington, D.C.

9) Director of Space and Electronic Warfare (OP-094), *The Copernicus Architecture: Functional Description Document (FDD),* Copernicus Project Office, Office of the CNO, Washington, D.C., August 1991.

10) Director of Space and Electronic Warfare (OP-094), *The Copernicus Architecture, Phase I: Requirements Definition,* Copernicus Project Office, Office of the CNO, Washington, D.C., August 1991.

11) Hammer, Michael, *Reengineering Work: Don't Automate, Obliterate*, Harvard Business Review, July - August 1990.

12) Hammer, Michael and Champy, James, *Reengineering the Corporation: A Manifesto For Business Revolution*, Harper-Collins Publishers, Inc., NY, 1990.

13) Intelligence and Communications Architecture (INCA), *Assessment of New and Emerging Communications Technologies,* December 22, 1993.

14) Intelligence and Communications Architecture (INCA), *Intelligence and Communications Support to a Deployed Joint Task Force (JTF): A Goal Intelligence and Communications Architecture (GICA),* October, 1993.

15) Kahan, James P., Worley, D. Robert, Stasz, Cathleen, *Understanding Commanders' Information Needs,* Arroyo Center, The RAND Corporation, Santa Monica, California.

16) Loveless, Bruce L., An Architectural Approach to Strategic Information System Planning for the Office of Naval Intelligence, M.S. Thesis, Naval Postgraduate School, Monterey, California, September 1994.

17) Marca, David A., and McGowen, Clement L., *SADT: Structural Analysis and Design Techniques,* McGraw-Hill Book Company, New York, 1988.

D. READING ASSIGNMENTS

1) Defense Information Systems Agency, *Technical Architecture Framework for Information Management (TAFIM), Volume 3, Architecture Concepts and Design Guidance, Version 2.0,* Defense Information Systems Agency Center for Architecture, Department of Defense, Washington, D.C., November 1, 1993.

   Class handout.

   Read: Pages 41 - 57.

2) Director of Space and Electronic Warfare (OP-094), *Copernicus* Information Pamphlet, Copernicus Project Team Director, Office of the CNO, Washington, D.C.

   Class handout.

   Read: Entire document.

3) Department of the Army, *The Vision: The Army Enterprise Strategy,* Department of Defense, Washington, D.C., 1993.

   Class handout.

   Read: Entire document.

4) Intelligence and Communications Architecture (INCA), *Intelligence and Communications Support to a Deployed Joint Task Force (JTF): A Goal Intelligence and Communications Architecture (GICA),* October, 1993.

   Class handout.

   Read: Entire document.

5) Loveless, Bruce L., *An Architectural Approach to Strategic Information System Planning for the Office of Naval Intelligence,* M.S. Thesis, Naval Postgraduate School, Monterey, California, September 1994.

   Class handout.

   Read: Pages 84 - 103.

6) Recommended, but optional:

   a) Defense Information Systems Agency, *Technical Architecture Framework for Information Management (TAFIM), Volume 4, Standards-Based Architecture Planning Guide, Version 2.0,* Defense Information Systems Agency Center for Architecture, Department of Defense, Washington, D.C., October 25, 1993.

      On reserve in the NPS library.

      Read: Chapter 4 and Appendix III.

E. STUDY QUESTIONS

1. General Questions

1) Why is it important to determine a target for the system-in-focus?

2) What are the benefits of describing the target system using the Structured Approach Framework?

2. Specific Questions

1) See Appendix E-7, TAFIM Volume III, Questions 24 - 37.

2) See Appendix E-12, Copernicus, All Questions.

3) See Appendix E-13, Army Enterprise Strategy, All Questions.

F. EXERCISES

Critique the Target Architecture described in:

> Intelligence and Communications Architecture (INCA), *Intelligence and Communications Support to a Deployed Joint Task Force (JTF): A Goal Intelligence and Communications Architecture (GICA)*, October, 1993.

Use the Structured Approach Framework to structure your evaluation.

Search for and report on strengths and weaknesses in the following areas:

1) Functional Considerations.

   a) Description(s) of system Functions.

   b) Impact of Functions on Physical assets and resources.

   c) Impact of Functions on Organization.

   d) Mapping of Functions to Physical assets and resources.

   e) Mapping of Functions onto Organizations.

2) Physical Considerations.

   a) Description(s) of Physical assets and resources and resources.

   b) Impact of Physical considerations on Functions.

   c) Impact of Physical considerations on Organization.

   d) Mapping of Physical assets and resources to Functions.

   e) Mapping of Physical assets and resources onto Organizations.

3) Organizational Considerations.

   a) Description(s) of Organizational considerations.

   b) Impact of Organization on Functions.

   c) Impact of Organization on Physical assets and resources.

   d) Mapping of Organizations to Functions.

   e) Mapping of Organizations to Physical assets and resources.

Individual work required.

Report length: ≤ 30 pages including appendices.

Suspense IAW Appendix B, Course Schedule.

MODULE 3 - THE STRUCTURED APPROACH PROCESS

SUBMODULE E - DEVELOPING MIGRATION CANDIDATES

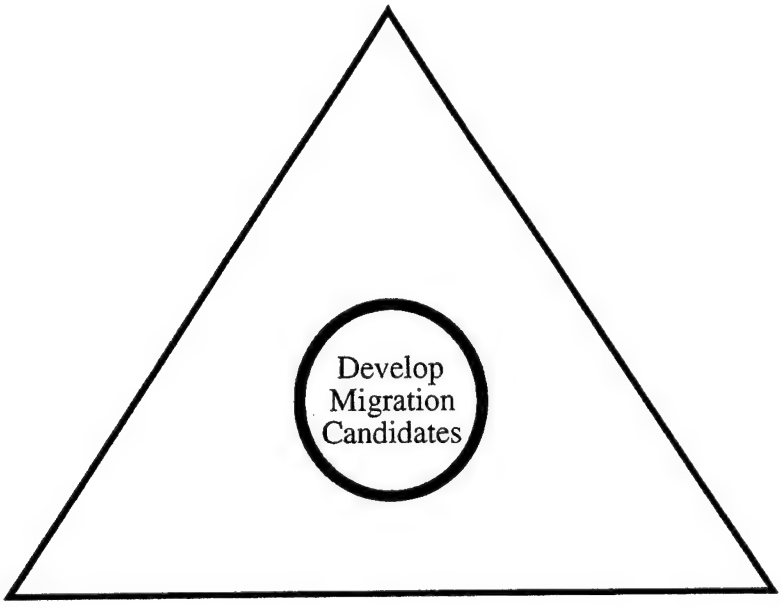


Figure M3E-1 Developing Migration Candidates Overview.

A. OVERVIEW

The fifth step in the Structured Approach Process is the Migration Candidate Development step. The purpose of this step is to develop several possible ways (plans, hardware, software, technical and managerial support, etc.) to migrate the existing (Baseline) system-in-focus toward the Target Architecture. The basic product of this step is a set of Migration Candidates. Each of the migration candidates should be described using all three views of the Structured Approach Framework: Functional, Physical, and Organizational. [Ref. Chapters 5 and 6 and Appendix VI]

B. LEARNING OBJECTIVES

1) Understand the need to develop several possible ways to "close the gap" between the baseline system-in-focus and the target system architecture.

2) Understand that the development of possible migration candidates should not be constrained by reality (cost / benefit analysis, business case justification, etc.).

3) Understand the benefits of describing migration candidates using the Structured Approach Framework.

C. REFERENCES

1) Assistant Secretary of Defense, Command, Control, Communications, and Intelligence (C3I), *Defense Information Infrastructure (DII) Integration and Migration Prototyping Project,* Decision Briefing for Emmett Paige, Jr., Washington, D.C., February 9, 1994.

2) Defense Information Systems Agency, *Technical Architecture Framework for Information Management (TAFIM), Volume 4, Standards-Based Architecture Planning Guide, Version 2.0,* Defense Information Systems Agency Center for Architecture, Department of Defense, Washington, D.C., October 25, 1993. Chapter 5, Appendix V

3) Egge, Daniel Q., A Framework for Evaluating Evolutionary Upgrade Paths of Command, Control, and Communications Systems, M.S. Thesis, Naval Postgraduate School, Monterey, California, June 1993.

4) Intelligence and Communications Architecture (INCA), *Assessment of New and Emerging Communications Technologies,* December 22, 1993.

5) Jones, Carl R., *Cost, Risk Analysis and Selection,* Class Notes, Naval Postgraduate School, Monterey, California, December 5, 1993.

6) Loveless, Bruce L., *An Architectural Approach to Strategic Information System Planning for the Office of Naval Intelligence,* M.S. Thesis, Naval Postgraduate School, Monterey, California, September 1994.

7) Loveless, B., Sweeny, T., Weatherford, M., *JMCIS and Naval Information Systems Migration,* Briefing Slides, Naval Postgraduate School, Monterey, California, May 1994.

8) Spegele, Joseph B., *A Framework for Evaluating Application of Smart Cards and Related Technology within the Department of Defense,* M.S. Thesis, Naval Postgraduate School, Monterey, California, September 1994.

9) Walsh, Edward J., *Navy Aims at Joint operations Roles and Economies for C4I,* Navy / Industry Technology Partnership, Sea Power, April 1994.

D. READING ASSIGNMENTS

1) Spegele, Joseph B., *A Framework for Evaluating Application of Smart Cards and Related Technology within the Department of Defense,* M.S. Thesis, Naval Postgraduate School, Monterey, California, September 1994.

   Class handout.

   Read: TBD.

2) Loveless, Bruce L., *An Architectural Approach to Strategic Information System Planning for the Office of Naval Intelligence,* M.S. Thesis, Naval Postgraduate School, Monterey, California, September 1994.

   Class handout.

   Read: Pages 104 - 117.

3) Recommended, but optional:

   a) Defense Information Systems Agency, *Technical Architecture Framework for Information Management (TAFIM), Volume 4, Standards-Based Architecture Planning Guide, Version 2.0,* Defense Information Systems Agency Center for Architecture, Department of Defense, Washington, D.C., October 25, 1993.

      On reserve in the NPS library.

      Read: Chapter 5 and Appendix V.

E. STUDY QUESTIONS

1. General Questions

1) Why is it important to develop several possible ways to "close the gap" between the baseline system-in-focus and the target system?

2) Why should the development of migration candidates not be constrained by reality (cost / benefit analysis, business case justification, etc.)?

3) What are the benefits of describing migration candidates using the Structured Approach Framework?

2. Specific Questions

None.

F. EXERCISES

None.

MODULE 3 - THE STRUCTURED APPROACH PROCESS

SUBMODULE F - SELECTING A MIGRATION PATH

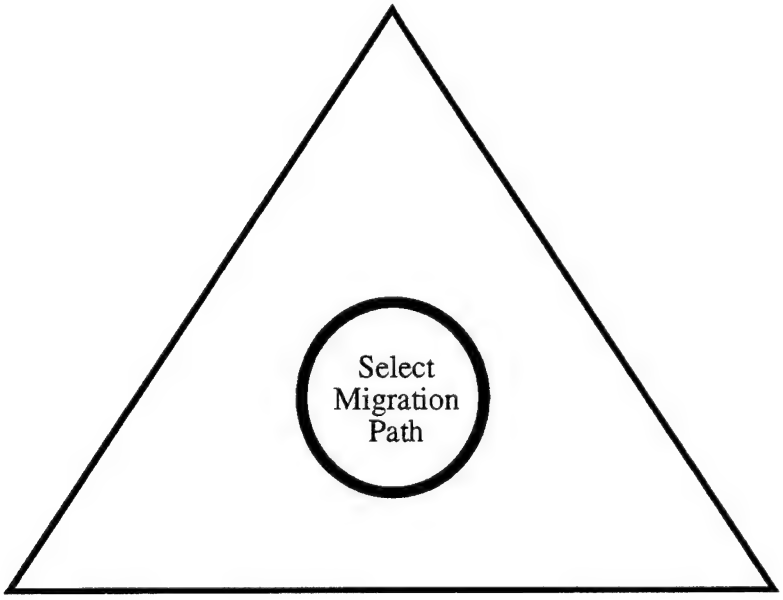


Figure M3F-1 Selecting A Migration Path Overview.

A. OVERVIEW

The sixth step in the Structured Approach Process is the Migration Path Selection step. The purpose of this step is to select the best way or combination of ways (plans, hardware, software, technical and managerial support, etc.) to migrate the existing (Baseline) system-in-focus toward the Target Architecture. The basic product of this step is a Systems Migration Plan or Path. The description of the selected migration candidate should incorporate all three views of the Structured Approach Framework: Functional, Physical, and Organizational. [Ref. 6, Chapter 6 and Appendix VI]

B. LEARNING OBJECTIVES

1) Understand the need to decide on one path (plan) or combination of paths for moving the baseline system-in-focus toward the target system architecture.

2) Understand that there are several ways to arrive at an optimum solution (select the best migration path).

3) Understand the benefit of applying the Structured Approach Framework to evaluate and compare alternative migration paths to select the best path.

C. REFERENCES

1) Anderson, David R., Sweeney, Dennis J., and Williams, Thomas A., *An Introduction to Management Science: Quantitative Approaches to Decision Making,* 6th Ed., West Publishing Company, St. Paul, Minnesota, 1991.

2) Loveless, B., Sweeny, T., Weatherford, M., *JMCIS and Naval Information Systems Migration*, Briefing Slides, Naval Postgraduate School, Monterey, California, May 1994.

3) Defense Information Systems Agency, *CIM Functional Economic Analysis Guidebook*, Version 1.0, Arlington, VA, January 15, 1993.

4) Defense Information Systems Agency, *Technical Architecture Framework for Information Management (TAFIM), Volume 4, Standards-Based Architecture Planning Guide, Version 2.0,* Defense Information Systems Agency Center for Architecture, Department of Defense, Washington, D.C., October 25, 1993.

5) Egge, Daniel Q., A Framework for Evaluating Evolutionary Upgrade Paths of Command, Control, and Communications Systems, M.S. Thesis, Naval Postgraduate School, Monterey, California, June 1993.

6) Jones, Carl R., *Cost, Risk Analysis and Selection,* Class Notes, Naval Postgraduate School, Monterey, California, December 5, 1993.

7) Loveless, B., Sweeny, T., Weatherford, M., *JMCIS and Naval Information Systems Migration*, Briefing Slides, Naval Postgraduate School, Monterey, California, May 1994.

8) Kahmenucur, Daniel and Lovalls, *Timed Choices and Bold Forecasts: A Logical Perspective on Risk Taking,* Management Science, Vol. 3, No. 1, January 1993.

9) Spegele, Joseph B., *A Framework for Evaluating Application of Smart Cards and Related Technology within the Department of Defense,* M.S. Thesis, Naval Postgraduate School, Monterey, California, September 1994.

10) Zahedi, Fatemah, *The Analytical Hierarchy Process: A Survey of the Method and Its Applications,* Interfaces, 16:4, July-August 1986.

D. READING ASSIGNMENTS

1) Spegele, Joseph B., *A Framework for Evaluating Application of Smart Cards and Related Technology within the Department of Defense*, M.S. Thesis, Naval Postgraduate School, Monterey, California, September 1994.

   Class handout.

   Read: TBD.

2) Loveless, Bruce L., *An Architectural Approach to Strategic Information System Planning for the Office of Naval Intelligence*, M.S. Thesis, Naval Postgraduate School, Monterey, California, September 1994.

   Class handout.

   Review: Pages 118 - 144.

3) Recommended, but optional:

   a) Defense Information Systems Agency, *Technical Architecture Framework for Information Management (TAFIM), Volume 4, Standards-Based Architecture Planning Guide, Version 2.0*, Defense Information Systems Agency Center for Architecture, Department of Defense, Washington, D.C., October 25, 1993.

      On reserve in the NPS library.

      Read: Chapter 6 and Appendix VI.

E. STUDY QUESTIONS

1. General Questions

1) Why is it important to decide on one path (plan) or combination of paths for moving the baseline system-in-focus toward the target system architecture?

2) What are some of the different ways to arrive at an optimum solution (select the best migration path)?

3) What are the benefits of applying the Structured Approach Framework to evaluate and compare alternative migration paths to select the best path?

2. Specific Questions

None.

F. EXERCISES

None.

MODULE 3 - THE STRUCTURED APPROACH PROCESS

SUBMODULE G - IMPLEMENTING THE SYSTEM PLAN

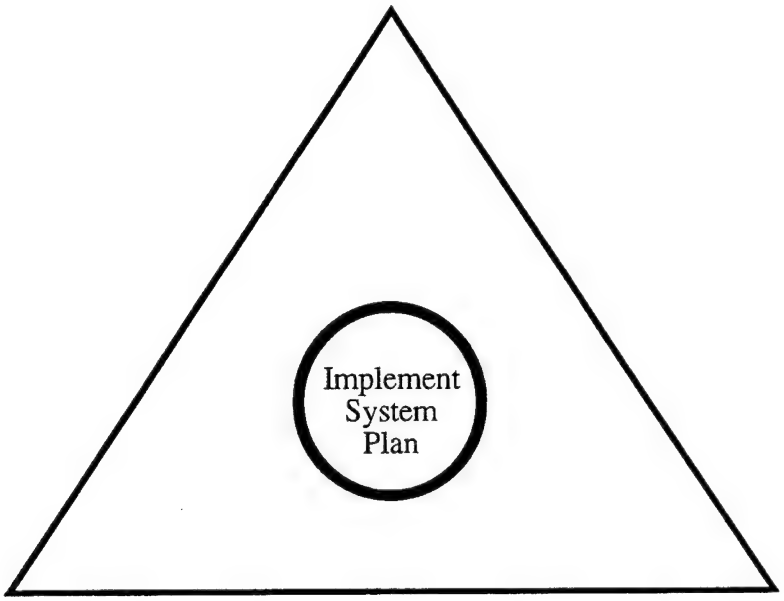


Figure M3G-1 Implementing The System Plan Overview.

A. OVERVIEW

The seventh step in the Structured Approach Process is the Implement the System Plan step. The purpose of this step is to execute the Systems Migration Plan that migrates the existing (Baseline) system-in-focus toward the Target Architecture. The basic product of this step is an evolving system (Baseline system moving toward the Target) and a set of Lessons Learned from the System Migration Plan implementation. The implementation plan should address all three views of the Structured Approach Framework: Functional, Physical, and Organizational. [Ref. 6, Chapter 7]

B. LEARNING OBJECTIVES

1) Understand the importance of having competent and committed leadership to implement the System Migration Plan.

2) Understand the benefits of monitoring the implementation of the System Migration Plan using the Structured Approach Framework.

C. REFERENCES

1) Beer, Michael, Eisenstat, Russell A., and Spector, Bert, *Why Change Programs Don't Produce Change*, Harvard Business Review, November - December 1990.

2) Bryant, Don, *The Psychology of Resistance to Change*, Management Services, March, 1979.

3) Covey, Stephen R., *The 7 Habits of Highly Effective People: Powerful Lessons in Personal Change*, Simon & Shuster, New York, 1989.

4) Defense Information Systems Agency, *Technical Architecture Framework for Information Management (TAFIM), Volume 4, Standards-Based Architecture Planning Guide, Version 2.0*, Defense Information Systems Agency Center for Architecture, Department of Defense, Washington, D.C., October 25, 1993.

5) Kotter, John P. and Schlesinger, Leonard A., *Choosing Strategies For Change*, from *Management Of Change*, a forthcoming Dow Jones - Irwin book.

6) Light, Paul, *Surviving Reinvention*, Management Focus, Government Executive, June 1994.

7) Loveless, B., Sweeny, T., Weatherford, M., *JMCIS and Naval Information Systems Migration*, Briefing and Briefing Slides, Naval Postgraduate School, Monterey, California, May 1994.

8) Mechling, Jerry, *Reengineering Tips for Federal Managers*, Business Process Reengineering: The Feds Go Back to the Drawing Board, A Supplement to Federal Computer Week, September 20, 1993.

9) Poza, Ernesto J. and Markus, M. Lynne, *Success Story: The Team Approach to Work Restructuring*, Organizational Dynamics, Winter 1980.

10) Tichy, Noel M., *Managing Strategic Change: Technical, Political and Cultural Dynamics*, John Wiley & Sons, New York, 1983.

D. READING ASSIGNMENTS

1) TBD.

2) Recommended, but optional:

a) Defense Information Systems Agency, *Technical Architecture Framework for Information Management (TAFIM), Volume 4, Standards-Based Architecture Planning Guide, Version 2.0,* Defense Information Systems Agency Center for Architecture, Department of Defense, Washington, D.C., October 25, 1993.

On reserve in the NPS library.

Read: Chapter 7.

E. STUDY QUESTIONS

1. General Questions

1) Why is it important to have strong leadership while implementing the system plan?

2) What are the benefits of monitoring the implementation of the system migration plan using the Structured Approach Framework?

2. Specific Questions

None.

F. EXERCISES

None.

MODULE 3 - THE STRUCTURED APPROACH PROCESS

SUBMODULE H - MAINTAINING THE SYSTEM PROCESS

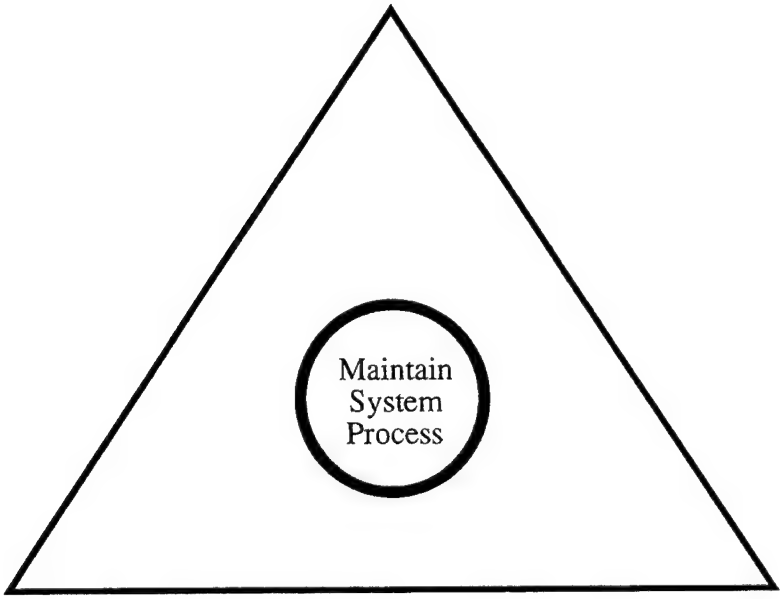


Figure M3H-1 Maintaining The System Process Overview.

A. OVERVIEW

The eighth and final step in the Structured Approach Process is the Maintain the System Process step. The purpose of this step is to maintain the Structured Approach Process itself. Users of the Structured Approach Process must include this step to ensure that the methodology continues to help systems engineers and managers operate and maintain (evolve) the system-in-focus effectively and efficiently throughout the life cycle of the system. The basic product of this step is a well-maintained process for engineering and managing the system-in-focus. Maintaining the system process requires viewing the entire Structured Approach Process using the Structured Approach Framework to determine what parts of the process require adjustment. [Ref. 6, Chapter 8 and Appendix VIII]

B. LEARNING OBJECTIVES

1) Understand the need to maintain the Structured Approach Process itself.

2) Understand the benefit of using the Structured Approach Framework to maintain the Structured Approach Process.

C. REFERENCES

1) Defense Information Systems Agency, *Technical Architecture Framework for Information Management (TAFIM), Volume 4, Standards-Based Architecture Planning Guide, Version 2.0,* Defense Information Systems Agency Center for Architecture, Department of Defense, Washington, D.C., October 25, 1993.

D. READING ASSIGNMENTS

1) TBD.

2) Recommended, but optional:

   a) Defense Information Systems Agency, *Technical Architecture Framework for Information Management (TAFIM), Volume 4, Standards-Based Architecture Planning Guide, Version 2.0,* Defense Information Systems Agency Center for Architecture, Department of Defense, Washington, D.C., October 25, 1993.

   On reserve in the NPS library.

   Read: Chapter 8 and Appendix VIII.

E. STUDY QUESTIONS

1. General Questions

1) Why is it important to maintain the Structured Approach Process itself?

2) What are the benefits of using the Structured Approach Framework to maintain the Structured Approach Process?

2. Specific Questions

None.

F. EXERCISES

None.

V. MODULE 4 - COMMAND AND CONTROL WARFARE (C2W):

AN APPLICATION OF ITM IN THE DOD

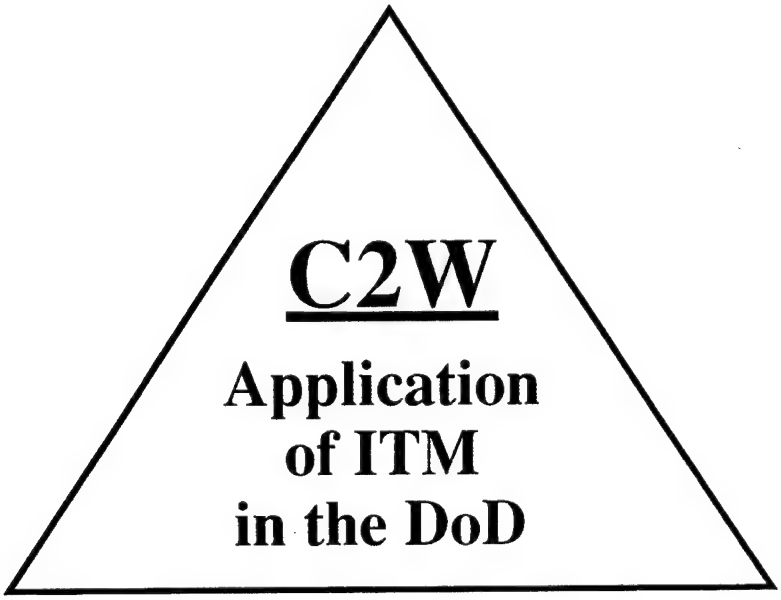


Figure M4-1 Command and Control Warfare Overview

A. OVERVIEW

The Military Technical Revolution is causing a revolution in command and control, communications, computers, and weapons systems. From classical ADP systems to modern tactical information systems, the DoD is experiencing improvements in horizontal integration, growth of common databases, increases in needs for massive communications capacities, and greater demand for better management, Command and Control (C2), and decision making. Both afloat and ashore, the DoD is continuing to learn how to adapt and apply information technology (IT) to meet the needs of military users throughout the "spear of war," from the "pointy end" to the "support tail." [Ref. 3] One of the more of the more significant applications of ITM in the DoD involves a new principal warfare area called Command and Control Warfare (C2W).

Chairman of the Joint Chiefs of Staff Memorandum Of Policy #30 (CJCS MOP 30), dated March 8, 1993, defines C2W as:

> The integrated use of Operations Security (OPSEC), military deception, Psychological Operations (PSYOPS), Electronic Warfare (EW), and physical destruction mutually supported by intelligence, to deny information to, influence, degrade or destroy adversary Command and Control (C2) capabilities while protecting friendly C2 capabilities against such actions. [Ref. 9]

CJCS MOP 30 further states that C2W is both offensive and defensive in nature and applies across the entire operational continuum. Information technology (IT) and its proper management enables commanders at all levels of conflict to apply C2W effectively to "decapitate the enemy's command structure from the body of its forces" while preventing the enemy from doing the same to friendly forces. This module introduces the fundamentals of C2W, its components, and its potential impact on future warfighting.

B. LEARNING OBJECTIVES

1) Understand the basic concepts of joint C2W.

2) Understand the nodal characteristics of functional C2 systems.

3) Understand how to conduct nodal analysis for C2W.

C. REFERENCES

1) Chairman of the Joint Chiefs of Staff, Memorandum Of Policy 30 (CJCS MOP 30), Subject: Command and Control Warfare (C2W), March 8, 1993.

2) Chief of Naval Operations (CNO) Message, Subject: Implementation CJCS MOPs 6 and 30, Electronic Warfare and Command and Control Warfare (C2W), Washington, D.C., October 19, 1993.

3) Commandant, Armed Forces Staff College, *Joint Command and Control Warfare Staff Officer Course Student Text,* Armed Forces Staff College, Norfolk, Virginia, January 1994.

4) Director of Space and Electronic Warfare (OP-094), *Space and Electronic Warfare: A Navy Policy Paper on a New Warfare Area,* Office of the CNO, Washington, D.C., June 1992.

5) Grindle, Clayton A. and Lipscomb, Michael P., *A Comparison of Command and Control Warfare and Space & Electronic Warfare,* November 3, 1993.

6) Memorandum for Fleet CINC's and OPNAV DCNO/ACNO's, Subject: Space and Electronic Warfare, July 8, 1992.

7) National Defense University, *Joint Command and Control Warfare Staff Officer Course (Student Text),* Armed Forces Staff College, Norfolk, Virginia, April 1993.

8) NAVMES@A1 message, Subject: Implementation CJCS MOPS 6 and 30, Electronic Warfare and Command and Control Warfare (C2W), October 19, 1993.

9) N64D Message, Subject: Change of SEW to C2W Terms and Definitions, October 27, 1993.

10) Oliva Jr., George and Pfeiffer, Theodore, *Winning the Information War: The Army's Answer to Command and Control Warfare,* Army Research, Development and Acquisition Bulletin, March-April 1994.

D. READING ASSIGNMENTS

1) Chairman of the Joint Chiefs of Staff, Memorandum Of Policy 30 (CJCS MOP 30), Subject: Command and Control Warfare (C2W), March 8, 1993.

   Class handout.

   Read: Entire document.

2) Commandant, Armed Forces Staff College, *Joint Command and Control Warfare Staff Officer Course Student Text,* Armed Forces Staff College, Norfolk, Virginia, January 1994.

   Class handout.

   Read: Chapters 1 and 3.

3) Recommended, but optional:

   Director of Space and Electronic Warfare (OP-094), *Space and Electronic Warfare: A Navy Policy Paper on a New Warfare Area,* Office of the CNO, Washington, D.C., June 1992.

   On reserve in the NPS library.

E. STUDY QUESTIONS

1. General Questions

1) Define C2W.

2) What are the elements of C2W?

3) What are the goals of C2W?

4) How does C2W fit into the spectrum of conflict?

5) What is a C2 node?

6) What are the components of a C2 node?

7) Explain what is meant by:

   a) Linked nodes.

   b) Dependent nodes.

   c) Critical nodes.

   d) Vulnerable nodes.

8) How do you determine friendly critical nodes?

9) How do you determine enemy critical nodes?

2. Specific Questions

1) The instructor may assign additional questions from:

   Commandant, Armed Forces Staff College, *Joint Command and Control Warfare Staff Officer Course Student Text,* Armed Forces Staff College, Norfolk, Virginia, January 1994.

2) Recommended, but optional:

   See Appendix E - 15, Space and Electronic Warfare (SEW).

F. GRADED EXERCISES

None.

VI. COURSE RETROSPECTIVE

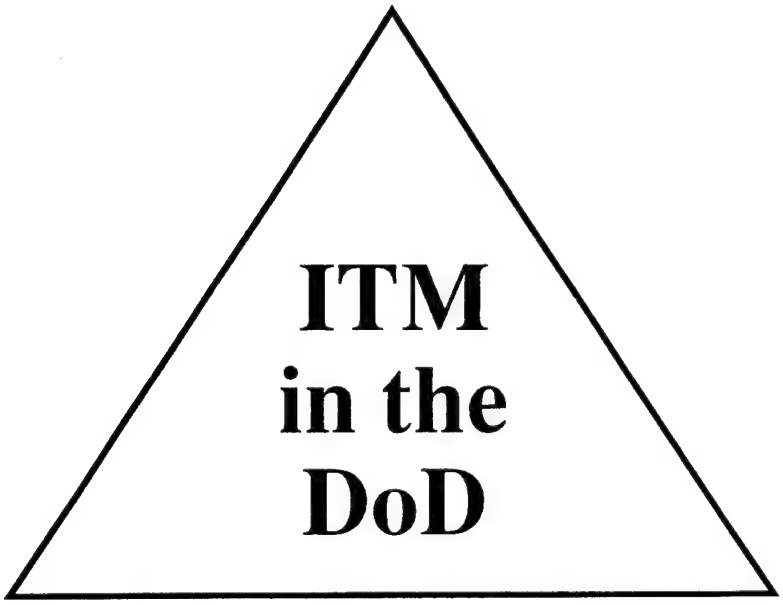


Figure VI-1 IS3112 - ITM in the DoD Retrospective.

A. OVERVIEW

1. Course Review

Information technology management (ITM) in the Department of Defense (DoD) has changed significantly during the last two decades. The pace of this change seems only to be accelerating as computer processing power continues to increase, data storage and retrieval capacity continues to grow, telecommunications capabilities continue to improve, hardware and software become more readily available, and automation costs continue to decrease. [Ref. 1, p. 19] Managers of information technology (IT) in the DoD need to know the answers to the following questions in order to manage DoD IT effectively and efficiently in an operating environment characterized by rapid and continuous change:

1) What impact are the Information Age and the Military Technical Revolution having on the DoD?

2) How can managers engineer and manage IT in the DoD more effectively and efficiently?

3) What new applications of IT are now possible in the DoD?

The ITM curriculum (#370) at the United States Naval Postgraduate School (NPS) in Monterey, California is designed to prepare military officers and defense civil servants (DoD civilians) to serve as managers of defense-related IT. The purpose of this instructional report was to present the answers to the three questions listed above in a way that would facilitate NPS graduate education of the DoD's future IT managers.

2. Course Content

This instructional report covered three interrelated topics concerning ITM in the DoD:

1) The Military Technical Revolution (MTR): The Changing DoD IT Environment.

2) A Structured Approach to Information Technology Management (ITM) in the DoD.

3) Command and Control Warfare (C2W): An Application of ITM in the DoD.

The conceptual framework in Figure VI-2 below illustrates the contents of the course.

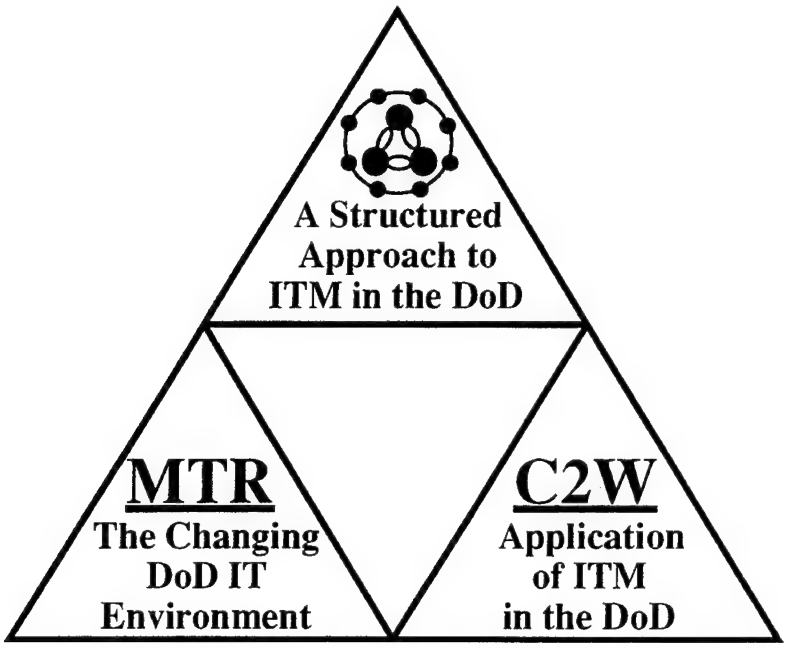


Figure VI-2 Course Framework for IS3112 - ITM in the DoD.

Each of these three subject areas addressed one of the fundamental questions presented in the course introduction. The MTR addressed the impact of the Information Age on warfare and presented some of the changes being caused by this revolution in military affairs. The Structured Approach to ITM in the DoD presented a systematic way for IT managers to manage IT effectively and efficiently in the ever-changing DoD operating environment. Finally, C2W: An Application of ITM in the DoD, introduced students to one of the more important applications of IT in the military: Command and Control Warfare (C2W).

B. LEARNING OBJECTIVES

1. Course Learning Objectives

There are eight main learning objectives for IS3112. The author based all module and submodule learning objectives on these eight course objectives. The learning objectives for this course and the module(s) in which they are covered are:

1) Understand the nature and the significance of the changes taking place in the DoD IT environment (Module 1 - The Military Technical Revolution: The Changing DoD IT Environment).

2) Understand the impact of the Military Technical Revolution on systems engineering and IT development in the DoD (Module 2 - A Structured Approach to ITM in the DoD: The Structured Approach Framework).

3) Be able to describe an information system and the organizational decision process(es) it supports in the context of operational and tactical decision making (C2 and C2 support) (Module 2 - A Structured Approach to ITM in the DoD: The Structured Approach Framework).

4) Develop an integrated framework for engineering and managing information technology and systems in DoD organizations (Module 2 - A Structured Approach to ITM in the DoD: The Structured Approach Framework).

5) Be able to apply a structured approach to information systems engineering and management based on the Technical Architecture For Information Management (TAFIM) (Module 3 - A Structured Approach to ITM in the DoD: The Structured Approach Process).

6) Become familiar with selected DoD information systems (Module 3 - A Structured Approach to ITM in the DoD: The Structured Approach Process).

7) Become familiar with the concepts of Command and Control Warfare (C2W) (Module 4 - C2W: An Application of ITM in the DoD).

8) Explore a subject area for thesis research in preparation for formal thesis proposal submission (Appendix G - Thesis Area Definition).

2. Education Skill Requirements (ESR's)

NPS creates, maintains, and administers curricula core courses to meet specific DoD and US Navy ESR's. The author and the ITM Academic Associate used the ESR's listed and explained in Appendix D, ITM Education Skill Requirements (ESR's), to redesign CM3112 and transform it into the current IS3112. The author and the ITM Academic Associate based all course, module, and submodule learning objectives on these ESR's. IS3112 satisfies ITM ESR's as indicated below in Table VI-1.

ITM Education Skill Requirement (ESR)	IS3112 Module				
	1	2	3	4	G
1. JOINT AND MARITIME STRATEGIC PLANNING			X		
2. INFORMATION SYSTEMS TECHNOLOGY					
a. Computer Systems					
b. Communication Systems and Networks		X			
c. Software Engineering			X		
d. Database Management Systems			X		
e. Decision Support and Expert Systems			X		
3. INFORMATION SYSTEMS ANALYSIS AND MANAGEMENT					
a. Managerial Concepts		X	X		
b. Evaluation of Information Systems		X	X		
c. Systems Analysis and Design		X	X		
d. Management of Information Systems		X	X		
e. Adapting To Technical, Organizational, and Economic Changes	X	X	X		
4. MILITARY APPLICATIONS					
a. DoD Decision Making Process on Information Systems		X			
b. Acquisition Management					
c. DoD Computer and Telecommunications	X	X	X	X	
d. C4I and C2W	X	X	X	X	
5. INDEPENDENT RESEARCH					X

Table VI-1 ITM ESR and IS3112 Module Matrix.

C. REFERENCES

The bibliography to this instructional report contains a complete list of references for IS3112. The Reference List found in each module and submodule lists all of the material that the author used to develop the content of the module or submodule.

D. READING ASSIGNMENTS

IS3112 reading assignments contribute to the achievement of course, module, and submodule learning objectives. The reading assignments in this instructional report:

1) Provide the student with background material on the subject covered in the module or submodule.

2) Stimulate student creative and critical thought.

3) Generate student interest in the subject matter.

(The are no assigned readings for the final module of this instructional report.)

E. STUDY QUESTIONS

The Study Questions section of each module and submodule contained questions based on the material covered in the module or submodule. There were two types of study questions in each module and submodule: General Questions and Specific Questions.

1. General Questions

1) What is the nature and the significance of the changes taking place in the DoD IT environment as a result of the Military Technical Revolution (MTR)?

2) What impact has the Military Technical Revolution had on systems engineering and IT development in the DoD?

3) Describe an information system and the organizational decision process(es) it supports in the context of operational and tactical decision making (C2 and C2 support) using the Structured Approach Framework.

4) Develop an integrated framework for engineering and managing information technology and systems in DoD organizations.

5) Apply a structured approach to information systems engineering and management based on the Technical Architecture For Information Management (TAFIM) (The Structured Approach Process).

7) Explain the fundamental concepts of Command and Control Warfare (C2W).

2. Specific Questions

None.

F. EXERCISES

The Exercises section of each module and submodule contained possible work assignments for students to complete either in or out of class. These exercises contributed to student education by challenging students to apply the material covered in the reading assignment, class lectures, previous NPS classes, prior work experience, etc. Completed exercises were graded in accordance with the instruction plan and grading scheme developed by the course instructor (see Appendix A, Course Specifics).

Submit final thesis area research report.

VII. CONCLUSION

Information technology management (ITM) in the Department of Defense (DoD) has changed significantly during the last two decades. The pace of this change seems only to be accelerating as computer processing power continues to increase, data storage and retrieval capacity continues to grow, telecommunications capabilities continue to improve, hardware and software become more readily available, and automation costs continue to decrease. [Ref. 1, p. 19] Managers of information technology (IT) in the DoD need to understand the answers to the following questions in order to manage DoD IT effectively and efficiently in an operating environment characterized by rapid and continuous change:

1) What impact are the Information Age and the Military Technical Revolution having on the DoD?

2) How can managers engineer and manage IT in the DoD more effectively and efficiently?

3) What new applications of IT are now possible in the DoD?

The ITM curriculum (#370) at the United States Naval Postgraduate School (NPS) in Monterey, California is designed to prepare military officers and defense civil servants (DoD civilians) to serve as managers of defense-related IT. This instructional report presented some possible answers to the three questions listed above in a format that will facilitate future 1) NPS graduate student education, 2) Instructor presentation of the material in this instructional report, and 3) The development of a new thesis format for presenting student research findings as instructional material for classes at NPS.

A. PURPOSE

The purpose of this instructional report is threefold: 1) To serve as a student text for future classes at NPS, specifically IS3112 - ITM in the DoD, 2) To serve as an instructor's guide for teaching IS3112, and 3) To serve as a model for a new type of NPS thesis report: the instructional report. This instructional report should serve all three purposes well.

1. The Student Text

This instructional report provides the first draft of a student textbook for IS3112 classes at NPS. This instructional report accomplishes this by presenting course subjects in a way that facilitates student learning. The course material introduced in this instructional report includes: 1) The Military Technical Revolution (MTR), 2) A Structured Approach to Information Technology Management in the DoD, and 3) Command and Control Warfare (C2W). This instructional report also contains an introduction to the thesis process at the Naval Postgraduate School (NPS).

2. The Instructor Guide

This instructional report provides faculty members at NPS with a draft teaching guide or preliminary instructional outline for presenting the IS3112 subjects listed above.

3. The Instructional Report Prototype

This instructional report contributes to the establishment of a new type of thesis report at NPS. It does this by providing a format for presenting material from student research as student text or supplement for courses offered at NPS. This new type of thesis report format, the instructional report, will complement the two existing types of NPS thesis reports: the thesis research report and the thesis technical report.

B. OBJECTIVES

There were three sets of objectives for this instructional report: 1) Student text objectives, 2) Instructor guide objectives, and 3) Instructional report prototype objectives. This instructional report met all three sets of objectives effectively.

1. The Student Text

The objectives for the student text are:

1) Facilitate student learning by providing a logical, organized way to study the material introduced in the instructional report.

2) Stimulate student interest by presenting some of the issues and challenges associated with the subjects introduced in the instructional report.

3) Develop student ability to analyze and critique course material through graded and non-graded study questions and exercises.

4) Assist student research and inquiry by providing lists of resources and references. The resources and references listed in this instructional report serve as a starting point for further study of the material introduced in the instructional report.

2. The Instructor Guide

The objectives for the instructor guide are:

1) Facilitate instructor preparation for presenting the subject matter by providing a sample course schedule and course module learning objectives, references, reading assignments, and study questions for each module and submodule.

2) Facilitate instructor presentation of the subject matter by providing a logical, organized way to cover the material in class.

3) Facilitate instructor development of student knowledge concerning the subject matter by providing material for use in class lectures and discussions.

4) Facilitate instructor evaluation of student understanding of the subject matter by providing module and submodule learning objectives, study questions, and exercises.

5) Facilitate instructor guidance of students who want to learn more about the subject matter by providing resource reference lists.

3. The Instructional Report Prototype

The objectives for the instructional report prototype are:

1) Contribute to the establishment of a new type of thesis report at NPS by providing an example or sample format for presenting student research findings as student texts or course supplements for use in classes at NPS. Two characteristics of this new style of thesis report are:

   a) General enough to be used by many of the departments and academic groups at NPS, yet specific enough to contribute to the education of NPS students.

   b) Modular in design with individual modules and submodules possessing a high degree of internal cohesion and a low degree of coupling. This gives instructors optimum flexibility when preparing and presenting material for a course.

2) Stimulate interest in producing instructional reports as part of the continuing effort to improve the quality of classes and their supporting instructional material at NPS.

3) Complement the two existing types of thesis reports at NPS: the thesis research report and the thesis technical report.

C. TARGET AUDIENCES

The three target audiences for this instructional report are: 1) NPS Students, 2) NPS Instructors, and 3) NPS Faculty and Staff.

1. NPS Students

The student target audience for this instructional report includes the following:

1) NPS Information Technology Management (ITM) students enrolled in IS3112 in fulfillment of Education Skill Requirements (ESR's) for the ITM curriculum (370). See Appendix D, ITM Education Skill Requirements, for a listing of ESR's for the ITM curriculum and an explanation of each ESR.

2) NPS students in curricula other than the ITM curriculum (370) who need to satisfy ESR's the same as or similar to those in the ITM curriculum (370). See Appendix D, ITM Education Skill Requirements, for a listing of ESR's for the ITM curriculum and an explanation of each ESR.

3) NPS students who have successfully completed or validated the prerequisite courses listed in Appendix C, IS3112 Course Prerequisites, or their equivalents.

4) Other individuals having both an interest in the subject matter and a need to know who meet the minimum security requirements for the course. See Chapter II, Course Organization and Administration, for security considerations.

2. NPS Instructors

The instructor target audience for this instructional report includes the following:

1) NPS instructors responsible for teaching IS3112 to satisfy ITM ESR's. See Appendix D, ITM Education Skill Requirements, for a listing of ESR's for the ITM curriculum and an explanation of each ESR.

2) NPS instructors responsible for teaching other classes at NPS which satisfy ESR's the same as or similar to those listed in Appendix D, ITM Education Skill Requirements.

3) NPS instructors having both an interest in the subject matter and a need to know, who meet the minimum security requirements for the course. See Chapter II, Course Organization and Administration, for security considerations.

3. NPS Faculty and Staff

The NPS faculty and staff target audience for this instructional report includes the following:

1) NPS faculty and staff responsible for establishing policy and standards for NPS thesis research and documentation (thesis reports).

2) NPS faculty and staff interested in developing a more effective way to use NPS thesis research to improve the quality of student education at NPS by presenting research findings in the format of an instructional report instead of a thesis research report or a thesis technical report.

D. METHODOLOGY

The author of this instructional report followed two different, but complementary methodologies to produce this instructional report; one for the content of the student text and instructor guide and another for the format of the instructional report.

1. Student Text and Instructor Guide Development

The author developed the content of this instructional report using the following process:

1) Assess the need for modifying or recreating an existing NPS course, CM3112 - Navy Telecommunication Systems (September - December 1993).

2) Analyze the existing course: CM3112 (September 1993 - March 1994).

   a) Analyze the existing course name and description.

   b) Analyze the existing learning objectives.

   c) Analyze the existing course syllabus.

   d) Review and evaluate the existing course materials.

3) Develop a new course based on the findings of 1) and 2) above (January - March 1994).

   a) Develop new course learning objectives.

b) Create a new course name and number: IS3112 - ITM in the DoD.

c) Select new course materials.

(1) Discard useless course materials from CM3112.

(2) Replace outdated course materials from CM3112 with updated versions.

(3) Search for and add new course materials.

d) Develop a new course outline.

e) Develop new course syllabi.

(1) Create a "Master Syllabus" containing general information about the course (course organization and administration).

(2) Create a "Detailed Syllabus" containing specific class information.

4) Refine the new course, IS3112 - ITM in the DoD, through repeated evaluation and modification. The author and principal advisor developed the items listed in paragraph 3 above using an iterative process (March - April 1994).

5) Teach the new course, IS3112 - ITM in the DoD, to 28 NPS ITM students (March - June 1994). This pilot class consisted of two ITM students from the September 1994 NPS graduating class and 26 ITM students from the March 1995 NPS graduating class. Professor Carl R. Jones, the Principal Advisor for this instructional report and the NPS ITM curriculum (370) Academic Associate (AA) served as the primary instructor for this class. The author of this instructional report assisted Professor Jones by presenting 12 hours of class instruction and by helping with the administration of the course. Professor James C. Emery, Associate Advisor for this instructional report, attended and actively participated in IS3112 classes , assisting with class administration and providing suggestions for the improvement of course content and format.

6) Evaluate the new course, IS3112 - ITM in the DoD, continuously throughout its administration. The author and the principal advisor made adjustments to the course as needed (March - June 1994).

7) Re-evaluate the new course and restructure weak areas (July - August 1994).

8) Reorganize course material (August - September 1994).

9) Write this instructional report in preparation for teaching the new course (IS3112) a second time from September to December 1994 (September 1994).

2. Instructional Report Development

The author developed the format for this instructional report in close cooperation with Professor Carl R. Jones, the Academic Associate for the ITM curriculum (370) and Principal Advisor for this instructional report. The author developed the format for this instructional report using the following process:

1) Examine the organization of the old course: CM3112 - Navy Telecommunications Systems (September 1993 - September 1994).

2) Examine the organization of the new course: IS3112 - ITM in the DoD (March - September 1994).

3) Examine the format for both the common NPS thesis research report and the thesis technical report (July - August 1994).

4) Obtain initial approval from the NPS Dean of Instruction for the development of a new thesis format to be called an "Instructional Report" (August 1994).

5) Develop the initial structure for this instructional report (August 1994).

6) Refine the format for this instructional report (August - September 1994).

7) Finalize and reproduce this instructional report (September 1994).

8) This instructional report will undergo further refinement and revision as NPS faculty and staff evaluate and modify it as part of the process of establishing a new type of thesis report for NPS.

The two processes which produced this first version of this instructional report proceeded simultaneously from September 1993 through September 1994. Both the content and the format of this instructional report will continue to evolve as NPS students and instructors use the IS3112 course modules and new thesis report format.

E. ORGANIZATION

The author organized this instructional report to serve all of the purposes stated in Section A above and to meet all of the objectives listed in Section B above. There are two ways to view the organization of this instructional report: the organization of the overall instructional report (the format of the instructional report) and the organization of the student text and instructor guide (the content of the instructional report).

1. Overall Instructional Report

This instructional report follows the basic format of a standard NPS thesis research report with only a few exceptions. This instructional report has introductory material, a main body, references, appendices, and an initial distribution list in accordance with current NPS thesis report guidelines. [Ref. 2] The main difference between a standard NPS thesis research report or thesis technical report and this instructional report lies in the organization of the material in the chapters of the report's body. The author organized the material contained in each chapter of this instructional report into blocks of instructional material called modules and submodules. Modules and submodules contain information that is unlikely to change as instructors and students use the instructional report in support of classes. The appendices of the instructional report contain information that is likely to change often, such as instructor information, course grading scheme, and course schedule.

2. Student Text and Instructor Guide

The author organized this instructional report into chapters, modules, and submodules as listed in the table of contents.

a. Chapters

Chapters contain the main areas of interest in this instructional report:

1) Course Organization and Administration (Chapter II).

2) The Military Technical Revolution: The Changing DoD IT Environment (Chapter III).

3) A Structured Approach to Information Technology Management in the DoD (Chapter IV).

4) Command and Control Warfare (C2W): An Application of ITM in the DoD (Chapter V).

5) Course Retrospective (Chapter VI).

Chapters III through V contains detailed blocks of instruction called modules.

1) Chapter III contains Module 1.

2) Chapter IV contains Modules 2 and 3.

3) Chapter V contains Module 4.

b. Modules

This instructional report contains four major blocks of instruction called modules. Each module covers one topic that contributes to the overall theme of the instructional report. Modules which contain a large volume of instructional material are further divided into submodules to facilitate study and presentation. This instructional report contains the following modules:

1) Module 1 - The Military Technical Revolution: The Changing DoD IT Environment.

2) Module 2- A Structured Approach to Information Technology Management in the DoD: The Structured Approach Framework.

3) Module 3- A Structured Approach to Information Technology Management in the DoD: The Structured Approach Process.

4) Module 4- Command and Control Warfare: An Application of ITM in the DoD.

Modules two (2) and three (3) are further divided into submodules due to the complexity of their subject matter and the large volume of material contained therein.

c. Submodules

The author further divided two of the modules in this instructional report into submodules. Submodules contain logical subsets of the material covered by the parent module. Submodules facilitate learning by reducing the complexity of the overall concept(s) or topic(s) covered by the parent module and by reducing the volume of the material covered at one time to a more manageable size. Modules two (2) and three (3) contain submodules as follows:

1) Module 2 - A Structured Approach to Information Technology Management in the DoD: The Structured Approach Framework.

   a) Submodule A - Functional Considerations.

   b) Submodule B - Physical Considerations.

   c) Submodule C - Organizational Considerations.

2) Module 3 - A Structured Approach to Information Technology Management in the DoD: The Structured Approach Process.

   a) Submodule A - Organizing and Planning.

   b) Submodule B - Defining the System Problem.

   c) Submodule C - Assessing the Baseline System.

   d) Submodule D - Determining the Target System.

   e) Submodule E - Developing Migration Candidates.

   f) Submodule F - Selecting a Migration Path.

   g) Submodule G - Implementing the System Plan.

   h) Submodule H - Maintaining the System Process.

d. Module and Submodule Contents

The author organized all modules and submodules into the following sections:

1) Overview.

2) Learning Objectives.

3) References.

4) Reading Assignments.

5) Study Questions.

6) Exercises.

(1) Overview. The Overview section of each module and submodule provides the reader with a general summary of the material presented in the module or submodule. The overview briefly describes the material covered, its relevance to the theme

of the instructional report, its challenges, and its potential impact. The overview may also introduce specific items of interest for the reader.

(2) Learning Objectives. Learning Objectives are key points, items of interest, or specific knowledge elements presented in the chapter, module or submodule. The students are responsible for accomplishing these learning objectives while studying the material contained in the module or submodule. The instructor is responsible for helping the student accomplish the learning objectives for each module or submodule.

(3) References. The References section of each module and submodule lists all of the source materials the author used to developing that particular module or submodule. The References section serves as a bibliography for each module and submodule and is a good place for students or the instructor to begin a search for additional reading material on the subject matter presented in the module or submodule.

(4) Reading Assignments. The Reading Assignments section of each module and submodule lists required student reading for that particular module or submodule. The instructor may tailor these reading assignments to suit specific class educational needs or meet time and schedule constraints.

(5) Study Questions. The Study Questions section of each module and submodule contains questions derived from the material covered by the module or submodule. Each Study Questions section has two parts: General Questions and Specific Questions.

(a) General Questions. General questions are general, broad, conceptual questions which focus on "the big picture." General questions are the types of questions students could expect to see on an examination because they require the student to integrate a wide variety of material from various reading assignments, class lectures, discussions, and projects. General questions often require students to draw on knowledge gained during previous classes at NPS and on practical experience acquired "on the job" or "in the fleet."

(b) Specific Questions. Specific Questions are highly detailed questions taken from specific reading assignments listed in the Reading Assignments section. These questions are not likely to appear on examinations because of their narrow scope, but they

do contribute to the development of the student's knowledge about the subject presented in the module or submodule.

(6) Exercises. The Exercises section of each module and submodule contains possible work assignments for students to complete either in or out of class. These exercises enhance student learning by requiring students to apply the material covered in reading assignments, class lectures, previous NPS classes, prior work experience, etc. in a new and challenging way. Completed exercises may or may not contribute to a student's grade, depending on the instruction plan and grading scheme developed by the course instructor. The course instructor may tailor exercises as necessary to optimize their contribution to the overall learning experience of the students.

The organization of this instructional report serves all of the purposes stated in Section A and meets all of the objectives listed in Section B. However, the organization of the IS3112 course material and the structure of the instructional report format may change slightly as students and faculty at NPS use this instructional report and modify it to meet specific needs. NPS students and faculty should apply the lessons they learn from the use of this instructional report to improve both its content and its organization.

F. SUMMARY

The true value of this instructional report will not be fully known until it is used in support of a class at NPS. The ITM Academic Associate and Principal Advisor for this instructional report will use Chapters II through VI (Course Organization and Administration, Modules I - IV, and Course Retrospective) of this instructional report as the primary student guide and instructor outline for the IS3112 class he will teach at NPS from September through December 1994. Approximately 48 ITM students, mostly members of the September 1995 NPS graduating class, will participate in the class. Hopefully, one or more of the students who take the class and use this instructional report will volunteer to work directly with the ITM Academic Associate to improve both the content and the format of this instructional report.

APPENDIX A Course Specifics

1. Instructor

Professor Carl R. Jones
Office: I-307
Phone: 656-2995
E-mail: 5220p@vm1.cc.nps.navy.mil
Office Hours: TBA

2. Class

Days: Mondays and Wednesdays
Times: Segment 01 1010 - 1200
Segment 02 1310 - 1500
Room: TBA
Class Schedule: See Appendix C - Course Schedule

3. Grading

Thesis Area Report 1	10 %	S: NLT 31 OCT 94
Baseline Assessment	30 %	S: NLT 14 NOV 94
Target Architecture	40 %	S: NLT 28 NOV 94
Thesis Area Report 2	20 %	S: NLT 12 DEC 94
	100 %	

Suspenses for graded requirements are also listed in Appendix B, Course Schedule.

4. Miscellaneous

a. Student Questionnaires

Each student will complete and submit a student questionnaire (Appendix A-1) to the course instructor NLT 28 SEP 94.

Students may either give their completed questionnaires to the instructor just before or just after class or may deposit the completed questionnaires in the instructor's administrative mail box on the second floor of Ingersoll Hall.

b. Project Teams

IS3112 students will work on the Baseline Assessment project in teams.

Students will organize themselves into teams of six students each (±1).

Each team will submit a list of team members to the course instructor NLT 03 OCT 94.

Teams may either give their member lists to the instructor just before or just after class or may deposit the member lists in the instructor's administrative mail box on the second floor of Ingersoll Hall.

c. Project Proposals

Project teams will submit their initial proposals for the Baseline Assessment project to the course instructor NLT 24 OCT 94.

The proposal should list the DoD or USN information system the team plans to evaluate for their Baseline Assessment and their preliminary sources of information.

APPENDIX A-1 IS3112 Student Questionnaire

1. **Name:** _____

2. **Rank:** _____ **Service:** _____

3. **SGC#** _____

4. **Voice Mail (NPS):** _____

5. **Telephone (Home):** _____

6. **E-mail Address:** _____

7. **Previous Tour Experience:**

_____

_____

_____

_____

_____

8. **Specific IT Interests:**

_____

_____

_____

_____

APPENDIX B Course Schedule

IS3112 **ITM in the DoD** as of **12 SEP 94**

Notable Dates:	**Event**	**(% of Grade)**
10 OCT 94	Columbus Day (Monday)	
31 OCT 94	Thesis Area Report 1 Due	(10%)
11 NOV 94	Veterans' Day (Friday)	
14 NOV 94	Baseline Assessment Due	(30%)
24 NOV 94	Thanksgiving Day (Thursday)	
28 NOV 94	Target Architecture Due	(40%)
12 DEC 94	Thesis Area Report 2 Due	(20%)

Dates (Week #)	**Subject**	**(Module / Sub Module #)**
26 - 30 SEP 94 (Week 1)	Course Organization and Administration	
	Thesis Area Definition	(Appendix F)
	MTR: The Changing DoD IT Environment	(Module 1)
03 - 07 OCT 94 (Week 2)	A Structured Approach to ITM in the DoD: The Framework	(Module 2)
	Functional Considerations	(Sub Module A)
10 - 14 OCT 94 (Week 3)	A Structured Approach to ITM in the DoD: The Framework	(Module 2)
	Organizational Considerations	(Sub Module B)
17 -21 OCT 94 (Week 4)	A Structured Approach to ITM in the DoD: The Framework	(Module 2)
	Physical Considerations	(Sub Module C)
24 - 28 OCT 94 (Week 5)	A Structured Approach to ITM in the DoD: The Process	(Module 3)
	Organizing and Planning	(Sub Module A)
	Defining the System Problem	(Sub Module B)
31 OCT - 04 NOV 94 (Week 6)	A Structured Approach to ITM in the DoD	(Module 3)
	Assessing the Baseline System	(Sub Module C)
07 - 11 NOV 94 (Week 7)	A Structured Approach to ITM in the DoD	(Module 3)
	Determining the Target System	(Sub Module D)
14 - 18 NOV 94 (Week 8)	A Structured Approach to ITM in the DoD	(Module 3)
	Developing Migration Candidates	(Sub Module E)
21 - 25 NOV 94 (Week 9)	A Structured Approach to ITM in the DoD	(Module 3)
	Selecting a Migration Path	(Sub Module F)
28 NOV - 02 DEC 94 (Week 10)	A Structured Approach to ITM in the DoD	(Module 3)
	Implementing the System (time permitting)	(Sub Module G)
	Maintaining the System Process(time permitting)	(Sub Module H)
05 - 09 DEC 94 (Week 11)	C2W: An Application of ITM in the DoD	(Module 4)
12 - 16 DEC 94 (Week 12)	Final Examination Week	

APPENDIX C Course Prerequisites

1. KNOWLEDGE BASE

Students enrolled in IS3112 must have successfully completed or validated the following courses at NPS or have a waiver signed by the ITM Academic Associate :

a. ITM 1st Quarter Courses

IS2000	Introduction to Information Systems Management

b. ITM 2nd Quarter Courses

CS3030	Computer Architecture and Operating Systems
OS3004	Operations Research for Computer Systems Managers
MN3105	Organization and Management

c. ITM 3rd Quarter Courses

IS4200	System Analysis and Design
EO2413	Introduction to Communication Systems Engineering
IS4183	Applications of Database Management Systems

d. ITM 4th Quarter Courses

IS3020	Software Design
EO3513	Communication Systems Engineering
IS4185	Decision Support Systems

2. CURRENT ENROLLMENTS

Students enrolled in CM3112 or IS3112 should be currently enrolled in or have successfully validated the following courses at NPS or their equivalent(s) in order to have the knowledge necessary to actively participate in the course:

ITM 5th Quarter Courses

EO3523	Communication Systems Analysis
IS3502	Computer Networks: WAN / LAN

APPENDIX D ITM Education Skill Requirements (ESR's)

With the Information Age has come a revolution in command and control, communications, computers, weapons, and Command and Control Warfare (C2W). From classical ADP systems to tactical systems, there is horizontal integration, common databases, massive communications needs, and better management and command and control decision making. Both afloat and ashore, the graduate of the Information Technology Management curriculum has the expertise and leadership to efficiently and effectively set requirements, design, implement, operate, and evolve information systems and C4I systems using the ever-changing information technology base. These graduates are a critical success factor for the adaptation of information technology to the needs of military users throughout the "spear of war" from the "pointy end" to the "support tail". The Information Technology Management graduate shall have the knowledge skills and competencies to:

1) Engineer Information Systems Afloat and Ashore.

2) Manage Information Systems, Centers and Commands Afloat and Ashore.

3) Solve Information Systems Engineering and Management Problems Individually and in Teams.

These general educational skill requirements are supported by the following topical educational skill requirements.

1. JOINT AND MARITIME STRATEGIC PLANNING

American and world military history and joint and maritime planning include the origins and evolution of national and allied strategy; current American and allied military strategies which address the entire spectrum of conflict; the U.S. maritime component of the National Military Strategy; the organizational structure of the U.S. defense establishment; the role of the Commanders of the Unified and Specified Commands in strategic planning; the process of strategic planning; joint and service doctrine, and the roles and missions of each in meeting national strategy.

2. INFORMATION SYSTEMS TECHNOLOGY

The officer must have a thorough knowledge of information systems technology to include:

a. Computer Systems

Computer systems and their components include central processing units, input / output devices, storage devices, operating systems, programming languages, distributed computer systems, and computer security.

b. Communication Systems and Networks

Communication systems and networks include PCM systems, AM, FM, TV, modulation, SATCOM, fiber optics, HF, microwave systems, error control coding, anti-jam communications, low probability of intercept communications, GPS, data encryption, wide- and local-area network hardware, software, components and systems, physical layer interfaces and protocols, communications software, network management and control, and communications security.

c. Software Engineering

Software engineering includes methodologies for the analysis, design, development, prototyping, testing, implementation and maintenance of software; software metrics and reliability; productivity analysis and software cost estimation and planning; man-machine interfaces and system ergonomics; CASE and I-CASE tools.

d. Database Management Systems

Database management systems include all database technologies (including object oriented), and technical and administrative issues involving the design, implementation, and maintenance of database management systems.

e. Decision Support and Expert Systems

Decision support systems and expert systems include information systems for problem identification, formulation, and design of systems to support decision making; application

of artificial intelligence technology to preserve perishable expertise and enhance distributed expertise; understanding the design of executive information systems, office automation, group decision support systems and crisis management systems, and their potential impacts on organizations and missions; integration of models; model management.

3. INFORMATION SYSTEMS ANALYSIS AND MANAGEMENT.

The officer must master the following concepts to effectively manage information system assets:

a. Managerial Concepts

Managerial concepts include decision-making theory, microeconomics, operations analysis, financial management, organizational development, and research methodologies.

b. Evaluation of Information Systems

Evaluation of information systems includes cost and operational effectiveness (benefit) analysis; selection, evaluation, acquisition, installation and effective utilization of information systems hardware and software; risk assessment; information system architectures involving alternative system concepts.

c. Systems Analysis and Design

Information systems feasibility studies and life cycle management including fact-finding techniques for determining system requirements and specifications, system performance evaluation, conversion and maintenance of legacy systems, and the post-implementation evaluation and security analysis of information systems.

d. Management of Information Systems

Management of information systems includes information systems facilities planning, production planning and control, requirements determination of information systems personnel, human resource management, budgeting and financial control of computer centers, design of effective organization structure and information systems, and control and security (INFOSEC) policies.

e. Adapting To Technological, Organizational, and Economic Changes

Adapting to technological, organizational, and economic changes includes evaluation of potential impacts of new technology on information systems planning and development and on organization strategy; appraisal of evolving responsibilities of information systems managers.

4. MILITARY APPLICATIONS

The officer must be able to combine analytical methods and technical expertise with operational experience for effective military applications to include:

a. DoD Decision Making Process on Information Systems

DoD decision making process on information systems includes DoD, DoN, OMB, and congressional decision making on information systems matters.

b. Acquisition Management

Acquisition management includes acquisition policies and procedures of the DoD, including the planning, programming and budgeting system; project management.

c. DoD Computer and Telecommunications

DoD computer and telecommunications includes architectures and specifications of Navy and DoD systems, computers, telecommunications networks and services, including the Defense Communication System (DCS); Navy fleet communications system, including satellite communications, WWMCCS, MIN, JMCIS, GCCS, and the Navy Telecommunications System (NTS); Decision Support Systems.

d. C4I and C2W

C4I and C2W include ITM concepts and their application to strategic, operational, and tactical level operations, including support.

5. INDEPENDENT RESEARCH

The graduate will demonstrate the ability to conduct independent research and analysis, and proficiency in communicating the results in writing and orally by means of a thesis and a command oriented briefing. The research in information technology and its management will include problem formulation, decision criteria specification, decision modeling, data collection and experimentation, analysis, and evaluation.

APPENDIX E Specific Study Questions

This appendix contains specific study questions based on references and reading assignments in the modules and submodules of this instructional report. The purpose of these specific study questions is to focus student attention on significant ideas and concepts presented in the course. Student ability to answer these questions will contribute to student understanding and application of the material presented in this instructional report.

APPENDIX E-1 The Military Technical Revolution

1. What are the three interrelated phenomena that have produced the Military Technical Revolution (MTR)?

2. What three significant factors will make future U.S. military operations more challenging?

3. What are three major concerns in "short-of-war" environments?

4. Define "Military Technical Revolution".

5. What are the two significant changes the West must make in the arena of conflict to respond to the Military Technical Revolution?

6. Name five reasons why the era of reliance on a strategy based on overwhelming force is drawing to a close?

7. What are the three relative strengths our potential adversaries may possess?

8. What are the six requirements for military forces in the information age?

9. What are the seven military capabilities needed to meet the requirements of information age?

10. What are the seven general types of systems which will have the effect of reducing force "overhead" while increasing firepower?

APPENDIX E-2 Information War - Cyberwar - Netwar

1. What is the DoD definition for strategy?
2. What is the capstone concept of Alvin and Heidi Toffler's book, *War and Anti-war* ?
3. Summarize JCS MOP 30 (Information War).
4. What are the three "waves" of warfare?
5. Describe netwar.
6. How is traditional propaganda changing?
7. What is the difference between "fictive" and "fictional?"
8. Give an example of how "truth" could be replace by "virtual reality."
9. What is ultimately being attacked in a strategic netwar?
10. What is the potential result of a strategic netwar?
11. What is "the acme of skill" in war?
12. Describe cyberwar.
13. What is the goal of cyberwar?
14. Does C2W = EW?
15. What are the computer tools of cyberwar (C2W)?
16. What is the moral nature of communication?
    a. What is the substantive purpose of communication?
    b. What is the pragmatic function of communication?
    c. What is the intoxicant function of communication?
17. What does sound military strategy require?
18. What is a potential hazard of C2W considering the requirements for military strategy?
19. In what way could cyberwar be the abolition of strategy?
20. Which is more demanding, cyberwar or netwar and why?
21. Could the US prosecute a strategic netwar successfully?

22. How might a war involving successful netwar be terminated?

APPENDIX E-3 The New Military Revolution
Post-Industrial Change

1. What were some of the problems of new technology during the Gulf War?

2. What are the categories of Roberts thesis which Ecovaria and Shaw used as a framework for assessing the newness and significance of military change in the post-industrial age?

3. What has the accuracy and swiftness of technologically enhanced military operations done for today's government officials?

4. What are Ecovaria and Shaw's three strategic forms?

5. What significant factor in warfare may be reduced as a result of computer technology's unlimited capacity for data processing and comparative analysis?

6. Is it likely that computer technology will someday reduce warfare to a science?

7. What is the impact computer technology is likely to have on the American tradition of relying heavily on a "citizens' army" (reserves)?

8. What are three of the sociopolitical consequences of post-industrial change on warfare?

9. What is the "Achilles' Heal" of post-industrial warfare and why?

APPENDIX E-4 Silicon and Security in the Twenty-First Century

1. What could advancements in microelectronics do to warfare as we now know it?

2. What two fundamental tasks on traditional battlefields are likely to change significantly as a result of technological advancements?

3. Who will have the advantage on the new hi-tech battlefield?

4. What are two components of battlefields of the future?

5. What technological improvements would be necessary to support a new dense, mobile grid in the ocean?

6. What impact is technology likely to have on a country's reliance on a few large, expensive traditional armed forces?

7. What is one potential danger of a large automated defense grid?

APPENDIX E-5 TAFIM Volume I

Overview

1. What is the purpose of TAFIM?
2. Explain the TAFIM implementation concept.
3. According to TAFIM, what are the three fundamental components of an Information System (IS) architecture?
4. What is the vision for DoD Information Technology (IT) in each of the following areas?
   a. Technology
   b. Product Availability
   c. Routine Operations
   d. Open Systems Environment
   e. Data and Information Security
   f. DoD Information Utility
   g. Shared Databases
   h. Backbone Network
   i. Streamlined Life Cycle
   j. Modeling and Prototyping
   k. Streamlined Acquisition
   l. Performance
   m. Education and Training
5. Explain the "Information Systems Life Cycle Support" model.
6. Explain the "Phased Convergence" to DoD Open Systems Architecture.
7. Describe the DoD Information Management (IM) integration model.
8. What are the two types of integration and how do they differ?

9. Explain each of the following levels of the DoD Integration Model (IM):

   a. Enterprise Level

   b. Mission Level

   c. Function Level

   d. Application Level

   e. Personal Level

APPENDIX E-6 TAFIM Volume II

Technical Reference Model (TRM) and Standards Profile Summary

1. What are the two principles upon which the DoD IM Initiative are based?
2. What is the purpose (three goals) of the DoD Technical Reference Model (TRM)?
3. Who is NIST and what are FIPS?
4. What principles will the TRM support in each of the following objectives?
   a. Improve User Productivity
   b. Improve Development Efficiency
   c. Improve Portability and Scalability
   d. Improve Interoperability
   e. Promote Vendor Independence
   f. Reduce Life Cycle Costs
   g. Improve Security
   h. Improve Manageability
5. Explain the generic DoD TRM?
6. Understand the Detailed DoD TRM and how it provides a framework for the DoD Profile of Standards.
7. Who developed the DoD Profile of Standards and what are the criteria?

APPENDIX E-7 TAFIM Volume III

Architecture Concepts and Design Guidance

1. Explain the concept of "Distributed Computing".
2. What are the three major benefits of "Distributed Computing"?
3. What four things does a "Technical Architecture" define?
4. TAFIM provides guidance on which types of information system interfaces?
5. What is an "API"?
6. What is an "EPI"?
7. Why is a standard API desirable for information systems that must interoperate?
8. What are the four "Views" of an information system architecture?
9. What are the six "Computer View" variations of an information system architecture?
10. Explain the five major variations of the "Client/Server" architecture.
11. Explain the "Host-Based" model.
12. Explain the "Master-Slave" model.
13. Explain the "Three-Tiered" model.
14. Explain the "Peer-to-Peer" model.
15. Explain the "Distributed Object Management" model.
16. What does a DBMS do?
17. What are the five essential functions of a DBMS?
18. What are the comparative strengths and weaknesses of the six most common data models?
19. What are the three transport components of the DoD Communications Infrastructure?
20. Explain the seven layers of the OSI Reference Model.
21. How do the four levels of the TAFIM communications framework align with the OSI Reference Model layers?
22. Explain the Abstract Security Architecture View.

23. What is an "Information Domain"?

24. Define "Architecture" using TAFIM terminology.

25. What are the advantages of the "Client/Server" computing model?

26. What are the disadvantages of the "Client/Server" computing model?

27. What are the strengths and weaknesses of the "Peer-to-Peer" computing model?

28. What is a RDBMS and why does TAFIM promote it?

29. What are the two "new" DBMSs becoming available that the DoD may want to consider using in the future and why?

30. Explain the two types of "Distributed" DBMSs.

31. How does a "Gateway" contribute to interoperability between distributed heterogeneous DBMSs?

32. What does a "Federated" DBMS do?

33. What is the difference between data "integrity" and data "availability" in TAFIM?

34. What is a "Point of Exposure" in an information system?

35. What capabilities will the DISN provide to the DoD?

36. What is a "Multiple Protocol Network"?

37. Summarize the five TAFIM methods for achieving interoperability between information systems using different communications protocols.

38. What four factors should be considered when selecting security mechanisms for an information system?

APPENDIX E-8 TAFIM Volume IV

Standards-Based Architecture Planning Guidance

1. What is the "bottom line" of (then) Deputy Secretary of Defense William J. Perry's policy memorandum of 13 October 1993 entitled "Accelerated Implementation of Migration Systems, Data Standards, and Process Improvement"?

2. What is the intent (purpose) of TAFIM Volume IV?

3. What are the four Information Technology (IT) views upon which TAFIM Volume IV is based?

4. What are the seven steps of the DoD Standards-Based Architecture (SBA) planning process?

5. What three products come out of SBA process step 1?

6. What is the purpose of a "Baseline Characterization" and what are its key dimensions?

7. What is accomplished during the "Target Architecture" SBA process step?

8. What is the purpose of "Opportunity Identification"?

9. What is the purpose of the "Migration Options" SBA process step?

10. In which SBA process step is a detailed implementation plan for migration efforts created?

11. In which SBA process step does continuous process improvement keep the new SBA alive and well?

12. What are the nine critical success factors of SBA planning?

13. What are the two main benefits of standards-based IT environments?

14. What is the TAFIM Volume IV definition of "Architecture"?

15. Who are the SBA "stakeholders" and how is this concept different from that of traditional IT planning?

16. What is required to establish a "Baseline Architecture"?

17. How accurate does a "Baseline Architecture" have to be?

18. What five key area are studied in a "Baseline Architecture" inventory?

19. What are the three ways work functions and processes should be cross-referenced to the components of the "Baseline Architecture"?

20. What are the six questions that should be answered during the "Technology Platforms" inventory?

21. What three criteria are used to assess applications?

22. What are the ten categories of "Technology Platforms"?

23. What are some typical "Platform Attributes"?

APPENDIX E-9 Volume 1 Command and Control

The Foundation

1. What is "Command and Control" (C2)?
2. What is "Command"?
3. What are the two sources of authority?
4. What is "Control"?
5. What are the three elements of C2?
6. What are the seven elements of the C2 Support Structure?
7. What does C2 do?
8. What should effective C2 accomplish?
9. What is the "Certainty Gap"?
10. What is "Knowledge"?
11. Why is time a problem for C2 (three reasons)?
12. What are the four timeless factors that influence C2?
13. What are the two prevailing characteristics of the Information Age that affect C2?
14. What is the ultimate measure of C2 effectiveness?
15. What is the OODA loop?
16. Why are images so important to C2?
17. What is a "Directed Telescope"?
18. What are the two responses to dealing with the fundamental problem of uncertainty? (Control Theory)
19. What is "Detailed Control"? (Control Theory)
20. What is "Mission Control"? (Control Theory)
21. Why is "Task Organizing" so important to C2? (Organization Theory)
22. What does "reasonable Span of Control" mean? (Organization Theory)
23. Describe "Communications". (Communications Theory)

24. What are the four general principles of C2 decision-making? (Decision-Making Theory)

25. In reference to decision-making, what are the defining features of the C2 problem?

26. Which of the two theories of human decision-making is more appropriate in C2?

27. What are the obstacles that a C2 system must overcome?

28. What are the features of an effective C2 system?

29. Why is "Mission Control" important to a C2 system?

30. Why is "Initiative" important to a C2 system?

31. Why is "Mutual Trust" important to a C2 system?

32. Why is "Implicit Understanding and Communication" important to a C2 system?

33. Why is "Recognitional Decision-making" important to a C2 system?

34. Why is "Information Management" important to a C2 system?

35. What is the importance of "focusing" C2 and what is one way a commander can provide focus?

APPENDIX E-10 USMC FMFM 3

Command and Control

1. Understand how Command and Control (C2) Theory links Decision-making to Execution.
2. What is "Directive Control"?
3. What is "Detailed Control"?
4. What is "C2 Warfare" (C2W) according to FMFM 3?
5. What are the fundamental elements of a C2 Infrastructure?
6. Describe an effective C2 infrastructure.
7. What are the six principles of Command?
8. What are the two types of Chains of Command?
9. What are the five types of Control?
10. What are the possible Command Relationships?
11. What are the four types of Support Relationships?
12. What are the three Echelons of Command?
13. Upon what three things does C2 effectiveness depend?
14. What are the two principles of Information Management?
15. What are the six properties of Quality Information?
16. What are the four properties of Information Flow?
17. What are the two factors governing the level of uncertainty?
18. What is a "CCIR"? Give several examples.
19. What does a commander do during the Decision Cycle?
20. What is a "Perfect Decision"?
21. What is a "Workable Decision"?
22. What are the four phases of Mission Execution?
23. What are the four steps of the Planning Phase?

24. What are the three steps of the Directing Phase?
25. What is the goal of the Controlling Phase?
26. When does the Coordinating Phase begin and end?
27. What is the objective of "Task Organization"?
28. What is the purpose of the C2 Support System?
29. What are the components of the C2 Support System?
30. What are the functions of the C2 Support System?
31. What are the characteristics of the C2 Support System?

APPENDIX E-11 C4IFTW

1. What is the vision of C4IFTW?
2. What is (are) the major problem(s) with many existing C4I systems?
3. What is the basis for C4IFTW?
4. What are the five external environmental factors driving C4IFTW?
5. What three technological areas require the most improvement in order to make C4IFTW possible?
6. Describe the "Warrior Terminal" of the future.
7. What is a "Warrior's Battlespace"?
8. What is the "Infosphere"?
9. Explain the C4IFTW equation:

   PULL + P2E2I + OTAU = Real Time Battlespace Information.

10. What is data "Fusion"?
11. Explain "Warrior Pull On Demand".
12. What are the three phases of the C4IFTW "road map"?
13. In which phase is the DoD now (ref. the C4IFTW "road map")?
14. What are three blocks of the C4IFTW foundation?
15. Explain the four blocks of the C4IFTW "New way of doing business".
16. What are the four "on-going efforts" of C4IFTW.
17. What does "JUDI" stand for and what does it do?
18. What are the four Service C2 systems selected for JUDI "proof of concept?"
19. Briefly describe the GCCS evolution concept.

APPENDIX E-12 The Copernicus Architecture

1. What are the two challenges of C4I strategy in the 21st Century?
2. What are the two CALOW missions most likely to occur in the 1990's?
3. What are the two central C4I problems of the 1980's that have carried over into the 1990's?
4. Why will CALOW missions be characterized as very data-intensive?
5. What are the four "knots" that bind the potential power of naval C4I?
6. What is "operational technologism"?
7. How does SEW (C2W) expand the CWC tactical continuum?
8. What are the differences between SEW and C4I?
9. Describe the three components of naval C4I.
10. What is the purpose of Copernicus?
11. When, where, and how was naval C4I "born"?
12. What lesson did Marc Antony (Actium, 31 B.C.), the US (Vietnam), and the USSR (Afghanistan) learn concerning military technology?
13. What is the main threat in the emerging geostrategic environment?
14. Where is the current "bottleneck" in the communications system?
15. What are the three most significant problems with SATCOM channels?
16. What is the main problem caused by narrative message formats?
17. What are the four levels at which Copernicus focuses on the operator?
18. What are "non-developmental building blocks"?
19. What are two false precepts of many current C4I systems?
20. What are the ten architectural goals of Copernicus?
21. What are the four central technological challenges involved with the ten architectural goals of Copernicus?
22. What are the four basic pillars of the Copernicus Architecture?

23. What two developments make possible the aggregation of many shore-based commands, both Navy and non-Navy, into powerful networks of "communities of common interests"?

24. Describe a GLOBIXS.

25. What are the eight standing GLOBIXS?

26. Describe a CCC.

27. What are the two possible permutations of the CCC?

28. What are the seven organizational building blocks of a Navy CCC?

29. Describe a TADIXS.

30. How will Copernicus attempt to correct the communications "bottleneck"?

31. Describe the flow of information between GLOBIXS and TADIXS on three conceptual planes.

32. What are the four broad categories of Copernican TADIXS?

33. Describe a TCC.

34. What is a FASTT?

35. What is the CSS?

36. What are the segments of the CSS architecture?

37. What are the four building blocks of the Copernicus Architecture?

38. What are the two types of network services on which Copernicus will rely?

39. On which communications services will GLOBIXS be based?

40. How do OSI network management standards relate to both GLOBIXS and TADIXS?

41. What will be the sources for the future FASTT HMI (Human-Machine Interface)?

42. What will be the primary source for standard Navy applications (word-processing, spreadsheet, etc.)?

43. What will be the likely source for TDA application software?

APPENDIX E-13 The Army Enterprise Strategy: The Vision

1. What is the purpose of the Army Enterprise Strategy?
2. What is the focus of the Army Enterprise Strategy?
3. What are the ten principles of the Army Enterprise Strategy?
4. What is "Horizontal Technical Integration"?
5. What are the five challenges of meeting the Warrior's information needs?
6. Define "Interoperability" in the C4I context.
7. What are "Split-base Operations"?
8. What are the major advantages of a "Digitized Battlefield"?
9. What is "Situational Awareness" and what are its major advantages?
10. What are the advantages of expanding the capabilities of power projection platforms?
11. Why is Multi-Level Security (MLS) necessary?
12. What is the fundamental problem in maintaining a technologically advanced fighting force?
13. What are the three keys to successful future system designs in the age of information warfare?

APPENDIX E-14 Sea Power
Ocean Venture '93

1. What is the goal of Copernicus?
2. What is the intent of C4IFTW?
3. Who is SPAWAR and what is their fundamental job?
4. What drives requirements for DON C4I systems?
5. How can information overload at the tactical user level be avoided?
6. What are the three broad tasks of C4I?
7. What are the four interrelated elements of the Transfer Information task?
8. What is a critical goal in handling massive volumes of data?
9. Summarize the intent of Operation Ocean Venture '93.
10. How will the Navy benefit from the integration of FDDS, JOTS, EWCM, and other C2 systems into NTCS/A?
11. What are some of the basic functions of NTCS/A?
12. What will be the ashore counterpart of NTCS/A?
13. What is the "unified build?"
14. What are the two main capabilities digitizing information can provide to users?
15. What is a potential problem with increasing reliance on COTS (Commercial Off-The-Shelf) products?
16. What purpose does JMCIS serve?

APPENDIX E-15 Space and Electronic Warfare (SEW)

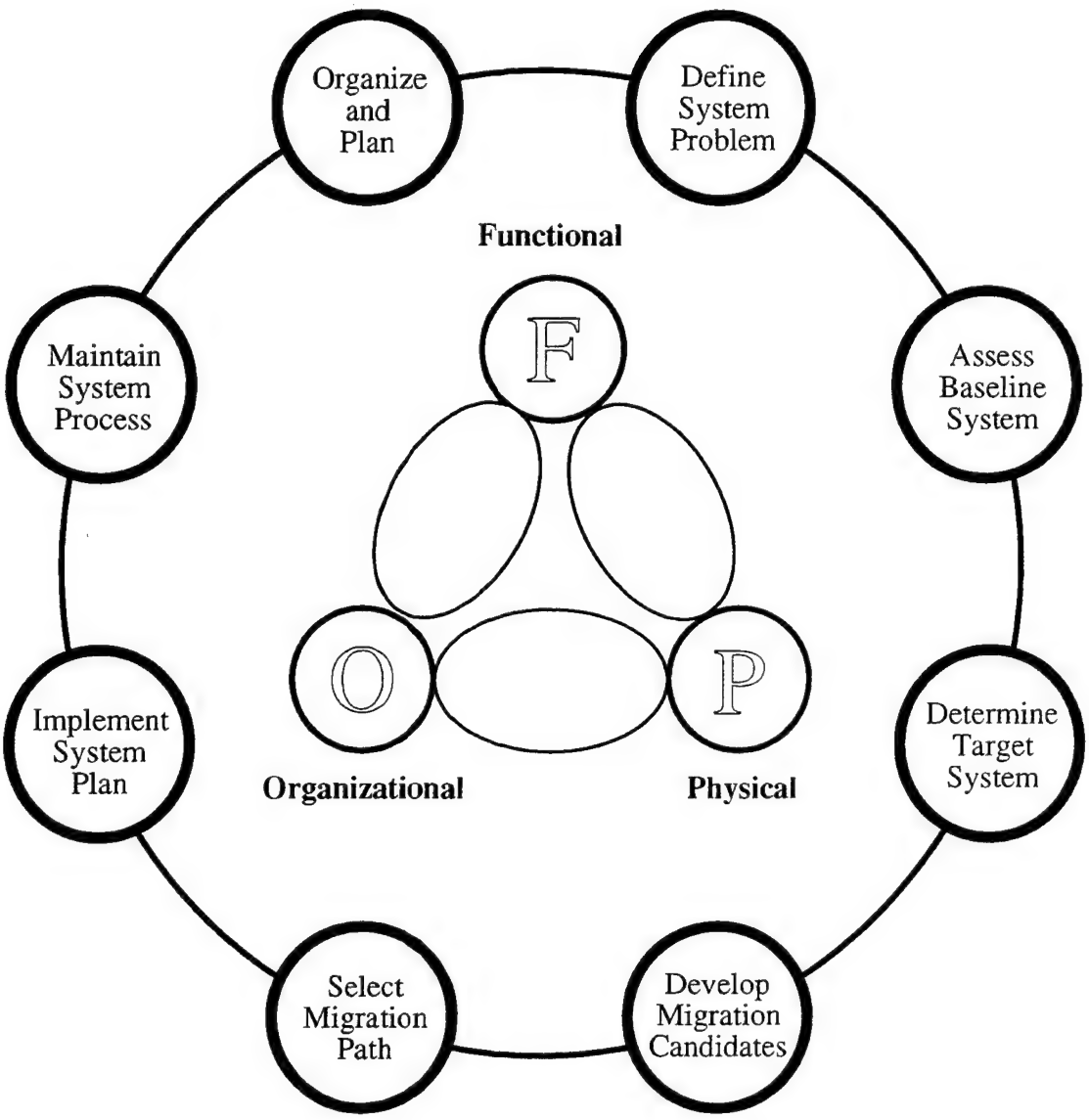
1. In future warfare, what will be the enemy's "strategic center of gravity"?
2. What are the two unique features of all principal warfare mission areas?
3. What are the three strategic objectives of SEW?
4. What is a "target set"?
5. What is the "target set" for SEW?
6. Define SEW.
7. What are the eight disciplines of the warfare and warfare support functions of SEW?
8. What are the five dimensions of battle space and which of these are most closely related to SEW?
9. What are the three requirements of SEW technology?
10. What are the three major technological subsystems of SEW?
11. What are the six keys to constructing the "Surveillance Grid"?
12. What are the three keys to constructing the "Communications Grid"?
13. What are the three difficulties related to the "Surveillance Grid" and the "Communications Grid"?
14. What is a GLOBIXS and what function(s) does it serve?
15. What is a CCC and what function(s) does it serve?
16. What is a TADIXS and what function(s) does it serve?
17. What is the analogy used to describe the challenge of operating in SEW battle space?
18. What are the six tiers of the SEW Battle Space Model?
19. What are the four sequential and repetitive techniques for conducting SEW?
20. What is the purpose of "Electronic Combat"?
21. What is the goal of "Electronic Combat"?
22. What are the main attributes of "Electronic Combat"?
23. How does the SEW Model relate to the AEGIS Model?

24. What is the "Tactical Grid"?

25. What are the three specific kinds of information that will be exchanged over the "Tactical Grid"?

26. What are the four functions of the SEW Commander?

APPENDIX F THE STRUCTURED APPROACH MODEL: FRAMEWORK AND PROCESS



APPENDIX G. THESIS AREA DEFINITION

A. OVERVIEW

Many of the curricula at NPS have one course which is unofficially called the "capstone course" by both students and faculty in that particular curriculum. This course usually acquires this nickname because it is held during the final quarter of a program of study and usually has a title that is fairly generic, i.e. broad and general. An example of this is IS4182, Information Systems Management, in the ITM curriculum (370). Although the course name, course description, and course content may be very broad and cover a wide variety of subjects taught during the previous seven quarters of instruction, this course is not really the "capstone" of a student's educational experience at NPS. That "honor" really belongs to the NPA academic requirement known by all as "the thesis."

B. LEARNING OBJECTIVES

1) Make a tentative thesis topic selection.

2) Become familiar with the process of selecting a thesis topic.

3) Become familiar with the process of defining thesis research questions.

4) Become familiar with the NPS thesis proposal format and the thesis document style.

C. REFERENCES

1) Brown, Thomas, *Thesis Manual,* Command, Control, and Communications (C3) Academic Group, Naval Postgraduate School, Monterey, California, May 1988.

2) Department of Administrative Sciences, *Student Guide for the Thesis,* Naval Postgraduate School, Monterey, California, July 1988.

3) Rhodes, C.G., Jones, C.R., Tryon, M., *Information Technology Management Student Handbook 1994*, Naval Postgraduate School, Monterey, California, April 1994.

4) Systems Management Joint Quality Management Board, *Faculty Research Interests,* Student Handout, Systems Management Department, Naval Postgraduate School, Monterey, California, March 4, 1994.

5) Thesis Processing Office, Naval Postgraduate School, *Thesis Preparation Manual,* Naval Postgraduate School, Monterey, California, April 20, 1994.

D. READING ASSIGNMENTS

1) Thesis Processing Office, Naval Postgraduate School, *Thesis Preparation Manual,* Naval Postgraduate School, Monterey, California, April 20, 1994.

   Obtain a copy from the curriculum office.

   Read:

   Entire document.

2) Rhodes, C.G., Jones, C.R., Tryon, M., *Information Technology Management Student Handbook 1994*, Naval Postgraduate School, Monterey, California, April 1994.

   Obtain a copy from the curriculum office.

   Read:

   Chapter II - ITM Thesis Process (pages 18 - 24).

   Peruse:

   Appendix C - ITM Thesis Topics (pages 80 - 82)

   Appendix D - ITM Faculty Interest Areas (pages 83 - 85)

   Appendix E - Thesis Proposal Format (Sample) (pages 86 - 90)

3) Systems Management Joint Quality Management Board, *Faculty Research Interests,* Student Handout, Systems Management Department, Naval Postgraduate School, Monterey, California, March 4, 1994.

   On reserve in the NPS library.

   Peruse:

   Entire document.

E. STUDY QUESTIONS

1. General Questions

1) Outline the process for selecting a thesis topic.

2) Outline the process of defining thesis research questions.

2. Specific Questions

There are no specific questions for this chapter of this instructional report.

F. GRADED EXERCISES

Write a Thesis Area Report

Write a six to ten page Thesis Area Report in NPS thesis proposal format (see Rhodes, Appendix E). You will research, develop, and report the following thesis-related items:

1) Area of Research.
2) Statement of Primary Research Question(s).
3) Discussion of Primary Research Question(s).
4) Scope of the Thesis.
5) Methodology.
6) Topical Chapter Outline (to at least three levels).
7) Schedule.
8) Benefits of Study.
9) Anticipated Travel and Funding Requirements.
10) Preliminary Bibliography.

The Thesis Area Report will be a two part graded exercise:

1. Thesis Area Report 1

The purpose of Thesis Area Report 1 is to help students begin the search for a thesis topic. Part one of the Thesis Area Report will cover only item numbers one through four and item number ten, listed above. Students may meet with the ITM Academic Associate to discuss thesis matters prior to the turn in date for this academic requirement.

2. Thesis Area Report 2

The purpose of Thesis Area Report 2 is to provide students with the opportunity to refine item numbers one through four and item number ten based on the instructor critique of Thesis Area Report 1 and to make additional progress toward having the material required for an official, formal NPS thesis proposal. Thesis Area Report 2 will include all ten thesis-related items from the list above. Students are *strongly encouraged* to meet individually with the ITM Academic Associate to discuss thesis matters prior to the turn in of this final Thesis Area Report.

The ITM Academic Associate will schedule thesis seminars for ITM sections during IS001 time periods (Thursdays, 1510-1700). These seminars will enable ITM students to meet NPS faculty and staff and learn about research projects currently underway at NPS and throughout the DoD. These seminars have proven to be a great help to graduate students searching for thesis topics in the past.

Students should discuss their thesis ideas with as many ITM curriculum professors as possible and should meet with the ITM Academic Associate individually at least once during the IS3112 quarter to discuss thesis matters. It is the responsibility of each student to schedule and participate in this preliminary thesis topic discussion with the ITM Academic Associate.

Students should be able to use this Thesis Area Report as the foundation for their official thesis proposals. However, these Thesis Area Reports will not "lock in" students to any particular thesis topic. This academic requirement is only intended to move students toward the selection of their actual thesis topics and the writing of their formal thesis proposals.

APPENDIX G-1 THESIS LECTURE OUTLINE

"SO WHAT IS A THESIS ALL ABOUT?"

I. Purpose of a Thesis

   A. Provide Independent Research Experience
   B. Link Education to Service Needs

II. Definition of a Thesis

   A. Independent Research under the Guidance of a Faculty Member
   B. Problem Definition and Resolution
   C. Communicating Results

III. Typical Thesis Outline

   A. Abstract
   B. Introduction
      1. Problem Definition
      2. Importance
      3. Summarization of the Solution
   C. Analysis of a Problem
   D. Results of Analysis
   E. Summary, Conclusions, and Recommendations
   F. Bibliography

IV. Thesis Types

   A. Analysis of a New System or a New Way to Operate an Old System
   B. Empirical Study
      1. Experiment
      2. Survey
   C. New Theory or Expansion of Existing Theory
   D. Case Study

V. Mechanics of a Thesis Effort

   A. Select a Specific Problem and Advisor
      1. Topic
      2. Advisor
      3. Literature Search
   B. Research Plan, Time Schedule, Initial Outline
   C. Execute Plan, Communicate Regularly with Advisor
   D. Write Rough Draft and get Advisor Review
   E. Additional Drafts and Reviews
   F. Polish Final Draft and get Signatures
   G. Final Preparation and Signatures
   H. Printing and Distribution

VI. Finding a Thesis Topic

A. A Problem from a Past Command
B. Lists of Service Problem Areas
C. Academic Associates and other Faculty
D. Ask your prospective next Command
E. Earlier Theses (NPS Library)
F. Students ahead of you in your Curriculum

VII. Thesis Advisor

A. Functions
    1. May provide Topic
    2. Research Guide
    3. Critiques written Thesis
B. Should be familiar with your Problem Area
C. See list of Faculty Research Interests
D. Ask other Students, Academic Associates, Professors, etc.
E. Multiple Advisors OK
F. Second Reader Reviews Thesis

VIII. Support

A. NPS Library
B. Local Literature Searches
C. DTIC Literature Searches

IX. Security

A. Classified
B. Proprietary
C. Secure Desk and Safe Access
D. Procedures

X. Writing the Thesis

A. Advisor
B. Thesis Manual

XI. Questions?

APPENDIX G-2 WHAT IS A THESIS?

by Professor William Haga March 1994

A report of an original contribution to a body of academic or professional knowledge.

It makes a contribution by solving a problem, clarifying an understanding, discovering new relationships among elements or by improving an organization.

It should sharpen your skill at critical inquiry.

WHAT CAN BE A THESIS?

Scientific inquiry.

Solution to a real-world problem.

Teaching case.

Literature review, but with a profound re-interpretation.

EXAMPLES OF PROBLEM SOLVING THESES

System requirements analysis.

Database specifications.

Specifying a procedure for doing a requirements analysis.

Study of system feasibility.

Model an organizational process.

Develop DSS or expert system.

Write a program.

Design a LAN.

VARIETY OF ORIGINAL MOTIVES IN CHOOSING A THESIS TOPIC

Just to get it over with.

Intellectual curiosity.

Career advantage.

Picking a topic just to get the thesis done has not been a barrier to becoming enthused about the topic.

SOURCES OF TOPICS

Faculty.

Your last billet.

Your experience: what didn't work.

Friends out in the real world.

Boss at your next billet.

Requests from research sponsors.

Sections ahead of you.

Courses.

CONSIDERATIONS IN CHOOSING A TOPIC

The topic must be narrow.

Is it do-able by you?

Is there enough time to do it?

Do data exist?

Will data sources cooperate?

Will you need travel funding?

How much reading?

How much data collection work?

How much statistical analysis?

How much writing?

THESIS MILESTONES

A	B
Choose topic	Find advisor
Enroll advisor	Accept topic

Submit final proposal NLT end of quarter six.

Prepare review of literature.

Collect data.

Analyze findings.

Write chapters.

Submit thesis NLT 2 weeks before graduation.

THE PLAYERS

Primary advisor and associate advisor or two co-advisors.

At least one must be a member of the Systems Management Department.

At least one must have a Ph.D.

Primary advisor must be a full-time faculty member.

THE HIERARCHY

Department Chair.

I.T. Group.

Academic Associate.

I.T. Group.

Thesis Associate	Project Sponsor
Primary Advisor	Associate Advisor

You

RELATIONSHIP WITH ADVISOR

More collegial than professorial.

Bounce ideas off each other.

Advisor helps define topic.

Advisor directs you to literature.

Advisor reads / criticizes chapters.

Advisor accepts / rejects thesis.

Advisor shapes evolving analysis.

Advisor discerns meaning of findings.

Advisor will be critical reference for suitability investigation

WHAT'S IN A PROPOSAL?

Names the players.

In a general way, tells what are you going to do.

Tentative title.

Concrete research questions.

Background of the topic.

Scope: what you will do and what you won't.

Outline of chapters.

Milestones toward completion.

Statement of benefits to DoD.

Preliminary bibliography.

WRITER'S BLOCK

Draft - fast, no editing.

Rewrite cold draft.

Write as if to section colleagues.

First draft before doing research.

Don't write - outline, detail outline, iteratively fill in outline.

Write introduction last.

Hire outside line editor.

BEFORE SHOWING IT TO ADVISOR

Spell check.

Grammar / style check.

Eyeball for punctuation.

Check for NPS thesis format.

Tear apart fan-fold paper.

Actually read it cover-to-cover.

APPROACHING GREEN CARD

Don't plan to finish writing chapters one week before graduation.

Implement helpful editorial suggestions from advisors.

Appendices.

List of references.

Abstract.

Dedication / acknowledgment.

Print final version.

Signature page signatures.

Distribution classification.

Thesis Processor's format check.

CAVEATS

Do not plagiarize
Research versus plagiarism.
Follow on thesis, not plagiarism.

Do not use text, drawings, cartoons, photos, graphs without specific written copyright permission.

Problems of classified thesis.

HOW THE WHEELS CAN COME OFF

No literature.

Too much literature.

Data sources are too busy.

Data sources don't like you.

No data.

Topic is sensitive.

Findings don't show anything.

Run out of time.

APPENDIX G-3 OUTLINE OF A TYPICAL RESEARCH REPORT THESIS

By William James Haga, Visiting Professor March 1994

Your thesis advisor's preferences have indisputable priority over this guidance. However, in lieu of any specific guidance from your advisor, this outline may help.

THESIS TITLE.

Keep it to one line. Don't confuse the title with the abstract.

ABSTRACT

Keep under 300 words. Tell the problem or issue that your thesis addressed, tell your source of data and summarize the most interesting of your findings. Write the abstract AFTER completing the thesis.

INTRODUCTION

Keep to 1.5 pages. Grab reader's interest. Answer this question: "Why was this study done at all?" Last paragraph briefly summarizes what was studies and how. But do NOT tell what you found, but rather convince reader they will live a happier and more harmonious life once they know what you found. Write the introduction AFTER you complete the rest of the thesis. Echo the closing paragraph of your conclusions section.

LITERATURE REVIEW

Who has already studied what you studied? Not every single last person who may have studied it, but the major figures. What did they find? Criticize their findings. Obviously they didn't do it correctly, big enough, with the correct sample at the right time using the proper methodology. Otherwise, you have nothing to do. What are their theoretical shortcomings? Was their sample representative? Did their data collection methods bias their findings? Did they miss a crucial dimension such as time? Or geography? After you leave them in tatters, write a transition that suggests that your study EXTENDS the work of these earlier scholars and improves upon it. Tell how you improved upon it. Always extend or evolve from the work of others. Academics are uncomfortable with radical departures from conventional thinking.

METHODOLOGY

A. Conduct Of The Study

This section should be mandatory if you collected data your own data or had a part in devising the data collection instruments. Otherwise it is optional. This section is a little narrative about the history of the study as you went through it. Sort of a diary. How did you get access to your sample? What bargains were made with the sample respondents to get them to go along? How did the instruments have to be fixed as you progressed? What games were played in cleaning and validating the data? Why were particular data analysis techniques used?

B. The Sample

Who or what was studied? How many respondents in the sample? What type of sample was drawn? What was the sample drawing technique? What are the demographics of the sample (race, gender, age, education, income, occupation)? Is this sample representative of any larger population?

C. Design of Data Collection

Were pretest and posttest groups used? Were comparison groups used. Was the control group comparable to the experimental group? If the research design was not at least quasi-experimental, how were conclusions protected against threats to internal validity?

D. Instrumentation

Were off-the-shelf instruments used? Were they modified? If new measures were used, tell why off-the-shelf measures were not suitable. If a pre-study of new instruments was conducted, what did it show? How were instruments changed as a result of pre-study?

E. Analysis Strategy

Wrap up methodology section/chapter by describing how you intend to analyze the data that were collected. Description? Hypothesis testing of causal inferences or association? This is NOT a detailed discussion.

FINDINGS

A. Measure by measure, question by question, what did you find? No editorializing. Just presentation of tables of findings. The narrative text of this section talks to the tables. Tables placed in body of thesis should summarize findings. Detailed, comprehensive tables should be in appendices.

B. Summarize the measure by measure findings from point to point in this section by showing broad results from a group of related measures.

DISCUSSION

A. What do all o f these findings mean? Discuss the general sweep of the findings group by group (groups of related measures, that is). You might have several measures of system productivity, Here, discuss the overall findings of the productivity measures as a group. Then discuss, say, the cost measures and so forth.

B. How did these findings relate to what you expected to find according to the literature review? If you used new measures and instruments, how do your findings compare to those of earlier scholars who used different instruments and measures?

CONCLUSIONS

A. So what? What did you find that made this study worthwhile?

B. In this section you can begin to editorialize a bit in drawing implications of these findings for the larger field of study of which this effort is now a part of the literature.

C. What flaws in earlier studies have been corrected? What research should be done next to look at things you couldn't get to?
D. Wrap up closing paragraph that is a little sales pitch for the importance of these findings.

LIST OF REFERENCES

List all sources (articles, books, interviews, documents) mentioned in the body of the thesis. List nothing else.

BIBLIOGRAPHY (optional)

This would be the list of references PLUS any other good stuff about which you believe the dear reader should know.

APPENDICES

APPENDIX G-4 THESIS WORDS TO AVOID

by Professor William Haga March 1994

Just what you need, a list of forbidden words. They are words and phrases that weigh heavily in sentences, slowing down a reader without adding to content. I find that deleting these words or phrases puts punch in writing.

WORD / PHRASE	COMMENT:
administrate	administer
all	how many, exactly?
all of the different	superfluous.
approximately	how many, exactly?
civilian	don't use over and over.
critique (as a verb)	criticize.
described above	sounds legalistic.
enable	find a stronger verb.
environment	over used these days.
extremely	rare is the event or quantity that is actually extreme?
few	how many, exactly?
future planning	planning.
helped	find stronger verb.
increasingly	at what rate, exactly?
many	how many, exactly?
more	must tell more than what?
most	how many, exactly?
necessary	superfluous.
numerous	how many, exactly?
one of the most	be specific: 2nd place? tenth place?
operational	bureaucratese.
orientated	oriented.
overcrowded	crowded.
overwhelming	whelming.
perform	find a stronger verb.
personnel	don't use over and over.
really	Valley Girl talk.
referencing	referring.
required	superfluous.
simplistic	simple.
some	how many, exactly?
there were	lots of "there" is a sign of trouble.
to be	find stronger verb.
utilize	three pretentious syllables instead of "use."
various	talk about the variety.
very	very, very < very < no very.
will have been	cures insomnia.

Do NOT use this list while you are whipping out your first draft.
That is the time to concentrate on what you are going to say rather than on nit-picking points of style.

The issue of "the" or "a".

"The" refers to a particular, concrete entity, for example:

"the" organization if you are talking about NPS.

"A" or "an" refers to an abstract concept, for example:

"an" organization when you don't mean any particular organization.

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